The Role of the Amygdala in Dreaming

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COMPULSORY DECLARATION

This work has not been previously submitted in whole, or in part, for the award of any degree. It is my own work. Each significant contribution to, and quotation in, this dissertation from the work, or works, of other people has been attributed, and has been cited and referenced.

Signature: Signed by candidate Date:____12/09/2014_____

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ABSTRACT

Neuro-imaging studies have strongly implicated the basolateral amygdala in dreaming (e.g. Maquet et al., 1996). Various neuropsychological dream theorists (Domhoff, 2001; Hobson, Pace-Schott & Stickgold, 2000; Revonsuo, 2000) propose central roles for the amygdala in dreaming (particularly in the generation of dream affect); however, little empirical research on its function in dreaming exists. Urbach-Wiethe Disease (UWD) is a very rare genetic condition that can lead to calcifications in the medial temporal lobes. This study analysed 26 dream reports collected from eight adult UWD patients with fully calcified basolateral amygdalae bilaterally, and compared them to 58 dream reports collected from 17 matched controls. Dream affect and various other dream characteristics were examined.

A number of significant results of small to moderate effect size were found. Notably, UWD patients' dream reports had a significantly higher mean intensity of positive affect than controls' dream reports, a significantly lower mean intensity of negative affect, a significantly higher mean intensity of PLAY, and a significantly lower mean intensity of RAGE. The UWD patients' dream reports were also significantly more wish-fulfilling than the controls' dream reports, were significantly less likely to be classified as nightmares, and had a significantly lower word count and narrative item count. These results are consistent with an extensive literature that implicates the basolateral amygdala in fear conditioning, emotional appraisal and in similar affective processes in waking life (e.g. LeDoux, 2003; Pessoa, 2010).

The dream reports were also analysed for instances of threat and escape, as well as for approach and avoidance behaviour, in order to test some of the hypotheses central to Revonsuo's (2000) threat simulation theory (TST) of dreaming. These analyses produced no significant results. Given that the amygdala is essential to Revonsuo's (2000) conceptualisation of dreaming as an evolutionarily adaptive mechanism to safely simulate threat avoidance, these findings contradict some of TST's central predictions.

In general, these findings suggest that the average dream of persons with bilateral basolateral amygdalae damage is significantly simpler, more pleasant, less unpleasant, more wish-fulfilling and less likely to be a nightmare than the average control dream. As such, the dream reports of the UWD patients seem strikingly similar to the dreams of young children.

CHAPTER 1 - INTRODUCTION

A large body of research and theory in the field of neuropsychology and related neurosciences deals with the topic of dreaming. Nevertheless, there is much disagreement between theorists regarding the mechanisms and processes involved in dreaming, and many unanswered questions remain. One largely unanswered question concerns the role of the amygdala in dreaming. This study aimed to shed light on this question by thoroughly examining the dreams of patients with bilateral basolateral amygdalae lesions due to Urbach-Wiethe Disease (UWD), a very rare genetic disorder that can cause calcification of the amygdala.

The Amygdala's Waking Function

The human amygdala is a small, almond shaped structure located deep within the medial temporal lobes. The amygdala is a complex structure made up of various nuclei that can be divided up into two major groups: the cortico-medial (or central) and the basolateral region or complex (see *Figure 1*). Some disagreement regarding the amygdala's exact structural organisation remains (LeDoux, 2007). Although the amygdala is clearly not a single mass, most researchers treat it as a unitary structure. However, some have argued that the different nuclei are in fact structurally and functionally entirely dissociable from one another and should not be grouped together at all (Swanson & Petrovich, 1998).

There is a vast literature on the amygdala, and a full review is neither possible nor useful here. I will focus on the link between the amygdala and emotional processing in waking life (see Pessoa & Adolphs, 2010, and Pessoa, 2010 for recent reviews), as this is the role that most authors attribute to the amygdala in dreaming.

A multitude of studies have connected the amygdala with affective processes (e.g. Adolphs, Tranel, Damasio & Damasio, 1994; Adolphs & Tranel, 2004; Feinstein, Adolphs, Damasio & Tranel, 2011; LeDoux, 2003; Yang et al., 2002). These studies have taken many forms, but recurrent findings implicate the amygdala in responses to affective visual stimuli, fear conditioning, and emotional memory. The amygdala has been most frequently linked to negative emotional processes (primarily to fear, and secondarily to anger), although a fair body of research has also linked the amygdala to positive emotions (e.g. Adolphs & Tranel, 2004; LeDoux, 2003; Yang et al., 2002; Siebert, Markowitsch & Bartel, 2003). The amygdala has been strongly implicated in both conscious and unconscious fearful and phobic responses to stimuli such as spiders or snakes (Ohman, Carlsson, Lundqvist & Ingvar, 2007). However, current thinking is moving away from viewing the amygdala as simply a fear, anger and

general emotion centre (Adolphs, 2010; Pessoa & Adolphs, 2010). The amygdala has more recently been conceptualised as a coordinator of cortical functioning during the processing of affective stimuli, and as an evolved 'relevance detector' (Pessoa & Adolphs, 2010; Pessoa, 2010; Sander, Grafman & Zalla, 2003).

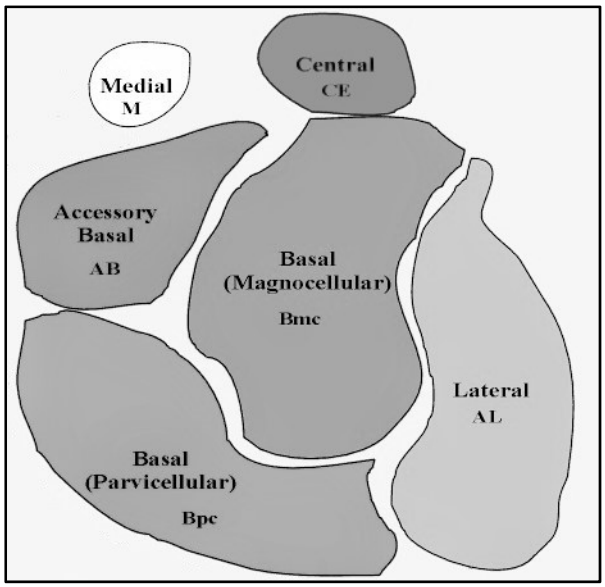

Figure 1. The basolateral complex of the amygdala is made up of the basal (Bpc & Bmc), lateral (AL) and accessory basal (AB) nuclei of the amygdala.

The Basolateral Amygdala

The UWD patients examined in this study have damage specifically localised to the basolateral complex of the amygdala bilaterally. The basolateral complex is made up of the basal, lateral and accessory basal nuclei of the amygdala (see *Figure 1*).

Until fairly recently, research on the amygdala in humans has tended to focus mostly on the structure as a whole rather than the individual nuclei (LeDoux, 2007). Based chiefly on findings in non-primate animals, the basolateral amygdala has been implicated in various types of affective processes. Such processes include fear and reward learning, as well as both the expression and extinction of conditioned fear (e.g. Adolphs, 2010; Killcross, Robbins, & Everitt, 1997; Sierra-Mercado, Padilla-Coreano, & Quirk, 2010). Generally speaking, the basolateral complex is thought to be the gateway to the amygdala (the lateral nucleus in particular receives input from a large number of brain areas), whereas the central nucleus of the amygdala is the chief output region (LeDoux, 2007; Phelps & LeDoux, 2005; Wilensky, Schafe, Kristensen, & LeDoux, 2006). The basolateral amygdala has also been shown to have extensive feedback projections to all regions of the visual cortex, with visual input

predominantly coming from higher-order visual association cortices (Adolphs, 2010; Pessoa & Adolphs, 2010). Based on these findings, Pessoa and Adolphs (2010) suggest that this area serves as *a zone of convergence for highly processed visual information that is relevant to the handling of affective stimuli*. Therefore, by virtue of the basolateral amygdala's direct connections to the visual cortex, the amygdala is thought to be able to enhance salient sensory processing.

Theories of Emotion and the Amygdala

Based on the research described above, various affective neuroscientists have attributed a crucial role to the amygdala (including the basolateral complex) in theories of emotional processing. The most commonly accepted idea is that the amygdala is a critical structure in mammal and human *fear* pathways (Ohman et al., 2007; Panksepp, 1998; Phelps & LeDoux, 2005), though (as stated above) this idea has recently been challenged. Panksepp (1998; 2005) suggested that seven 'basic emotion' systems (namely the FEAR, RAGE, SEEKING, PLAY, GRIEF, CARE and LOSS systems) are structurally and psychologically identifiable in all humans and other mammals. The amygdala, along with the periaqueductal grey, are considered to be the critical structures in the evolutionarily-primitive FEAR network. Panksepp (2014) also proposed that the amygdala may be involved in the RAGE network.

Dreaming and the Amygdala

The amygdala has been strongly implicated in dreaming by numerous neuroimaging studies. The amygdala shows higher activity levels during both REM (e.g. Dang-Vu et al., 2005; Maquet et al., 1996; Palagini & Rosenlicht, 2011; Nofzinger, Mintun, Wiseman, Kupfer, & Moore, 1997) and non-REM sleep than it does during waking (Nofzinger et al., 2002). Maquet et al. (1996) also found that bilateral amygdala activation during REM sleep was followed by dream recall on awakening. In addition, cortical areas that are rich in afferent connections from the amygdala (such as the anterior cingulate and the right parietal operculum) are active during rapid-eye movement (REM) sleep, while areas with low levels of afferent connections from the amygdala (such as the prefrontal cortex, other parietal cortex and the precuneus) are generally deactivated during REM sleep (Maquet et al. 1996). However, the amygdala's function in dreaming remains poorly understood.

Dream Research and the Amygdala

Very little empirical research exists regarding the amygdala's function in dreaming. De Gennaro et al. (2011) investigated the relationship between quantitative and qualitative measures of dreams reported in dream diaries, and the volume and mean diffusivity of the amygdala and hippocampus. Increased mean diffusivity of a brain structure is an indication of that structure's decreased structural integrity. These authors argue that the amygdala and hippocampus work together to determine the emotional qualities of dreams, and they hypothesised that the volume and structural integrity of these grey matter regions would be associated with variations in the quantitative and qualitative characteristics of dreams.

De Gennaro et al. (2011) report that decreased micro-structural integrity of the left amygdala was linked to shorter dream reports and lower emotional load in the dream reports. However, decreased volume of the right amygdala was associated with increased emotional load. They also found that decreased micro-structural integrity, and decreased volume of the right amygdala were associated with increased bizarreness in dream reports. The authors interpreted these findings as supporting two basic assumptions of Hobson, Pace-Schott and Stickgold's (2000) Activation - Input source - Modulation (AIM) model of dreaming (see below). Namely, De Gennaro et al. (2011) found support for Hobson et al.'s (2000) idea that the emotional salience of dreams is linked to amygdala activation and their idea that bizarreness in dreams is linked to decreased prefrontal inhibition of hippocampal and amygdalar functioning. De Gennaro et al. (2011) also proposed that amygdala function during dreaming might differ on the basis of hemispheric lateralisation, and that the amygdala may be differentially involved in positive and negative dream affect. The authors suggested that future research should investigate these possibilities

Wiest and Brainin (2010) presented three dream reports in their neuropsychoanalytic analysis of a single UWD patient with selective bilateral lesions of the amygdala. This paper constitutes the first evidence in the literature that patients without a functioning amygdala can dream at all. Wiest and Brainin (2010) reported that the patient had difficulty recalling his dreams, and that he could not produce any associations to his dreams.

Lastly, the body of research linking abnormal limbic system activity to nightmares and excessive negative emotion in dreaming (e.g. Levin, Fireman & Nielsen, 2010) may be of relevance, as the basolateral amygdala forms part of this system. Nielsen (2005) reported that the dreams of patients suffering from temporal lobe epilepsy contain more negative emotions, as well as more intense emotions, than the dreams of healthy controls. Germain et al. (2013) report increased limbic activation in the REM sleep of patients with post-traumatic stress

disorder. Some studies have also suggested that the amygdala plays a role in the processing of emotional memories during REM sleep and/or dreaming (e.g. Van der Helm et al., 2011).

Dream Theories and the Amygdala.

In forming ideas about the amygdala's role in dreaming, dream theorists have drawn chiefly on research and theory implicating the amygdala in waking emotional processes (see above), as well as observations that link limbic seizure activity to nightmares and highly unpleasant dream content. Numerous papers have drawn a link between high levels of amygdala activation during REM and the intensity of emotional experiences reported in dreams (e.g. Braun et al., 1997; Dang-Vu et al., 2005; De Gennaro, Marzano, Cipolli,, & Ferrara, 2012; Maquet et al., 1996; Palagini & Rosenlicht, 2011). Consequently, a number of influential neuroscientific dream theorists (Domhoff, 2001; Hobson et al., 2000; Levin & Nielsen, 2007; Revonsuo, 2000) have proposed a central role for the amygdala in producing, modulating and recalling emotional dream content, experiences, and reactions in dreams, and especially those involving negative emotions such as fear and anger.

The most relevant of these theories are described in more detail below. Although this review should ideally focus on the possible role of the *basolateral* amygdala in dreaming, dream theorists have not proposed differential roles for the different nuclei, and have instead referred to the amygdala as if it were a unitary structure. However, as demonstrated by the research presented above, the basolateral amygdala has been implicated in the majority of the affective processes that have been associated with the amygdala as a whole. Therefore, it is likely that the basolateral amygdala plays a significant role in whatever processes dream theories ascribe to the amygdala as a whole.

Domhoff (2001; 2011)'s continuity hypothesis of dreaming sees dreaming as being continuous on waking thoughts and concerns, and also argues that there is much continuity in the themes and events within the multiple dreams of any one individual. Within this theory, the amygdala is thought to play a similar role in dreaming to its role in waking life, namely in negative emotional processes (Domhoff, 2001).

Within their Activation Level - Input Source - Mode of Processing (AIM) model of dreaming, Hobson et al. (2000) attribute the intensity of emotion in dreams to the high level of amygdala activation during recorded REM sleep, while also arguing that the amygdala may underlie dreaming's supposed role in processing emotional memories. Most specifically, they state that; "the cortex of the dreaming brain is compelled to process internal signals arising from the pons and amygdala ... The limbic lobe may then direct the forebrain to

construct dreams" (Hobson et al., 2000, p. 838). Hobson (2004) also suggests that the amygdala plays an important role in the development of dream plots.

Levin and Nielsen (2007) describe the AMPHAC (amygdala, medial prefrontal cortex, hippocampus and anterior cingulate cortex) neurophysiologic model of disordered dreaming. In 2005, Nielsen and Stenstrom suggested that the amygdala is involved in the triggering of memories that form the basis of emotional experiences in dreaming, thereby directing dream plots. Levin et al. (2010) go a step further, and put more emphasis on the amygdala's importance in dreaming than on any other brain structure. These authors suggest that disordered dreaming, such as nightmares, may be caused by the amygdala becoming excessively responsive to fear-related content in dreams. Evidence suggests that the limbic system may be over-activated in patients who suffer from severe nightmares (Levin et al., 2010).

For Solms (1997; 2000), the mesocortical and mesolimbic dopaminergic pathways, which project from the ventral tegmental area of the brain to the frontal areas to the nucleus accumbens, and not the amygdala, are the critical pathways for dreaming. These pathways make up what Panksepp (1998) labelled the SEEKING system and they are thought to be responsible for the positive, appetitive affective urge that drives goal-directed behaviour (Alcaro, Huber, & Panksepp, 2007). Although the SEEKING system does project to the amygdala, Solms does not propose a key role for the amygdala in the dreaming process. However, it is important to recognise that Solms's model of dreaming was based mainly on lesion studies, and it is extremely rare to obtain focal lesions localised to the amygdala bilaterally.

In contrast to Solms, the threat simulation theory of dreaming (TST) developed by Revonsuo (2000), places a good deal of importance on the amygdala's role in dreaming. Threat simulation theory approaches dreaming from an evolutionary perspective, hypothesising that dreams are evolutionarily adaptive in that they constitute opportunities for the mind to practice (in safety) how to react to threatening situations quickly and effectively. In this theory, dreaming essentially entails threat simulation, which is thought to be generated by what Panksepp (1998) called the FEAR system. Given that the basolateral amygdala is the central part of the FEAR system, it should play a crucial role in Revonsuo's (2000) conceptualisation of dreaming. According to TST, the very purpose of dreaming is the priming of this amygdalocortical network – that is to say, fear conditioning (Zadra, Desjardins, & Marcotte, 2006). Threat simulation theory is called into question by evidence that experiences of realistic life-threatening events in dreams are rare, and that the successful

avoidance of these threats is even rarer (Malcolm-Smith & Solms, 2004; Malcolm-Smith, Solms, Turnbull, & Tredoux, 2008; Zadra et al., 2006). On the contrary, it has been reported that incidence of 'approach' dreams are more common than 'avoidance' dreams in populations living in both low- and high-threat environments (Malcolm-Smith et al., 2012).

Urbach-Wiethe Disease

Investigating the dreams of patients with amygdala damage presents a unique avenue for exploring the aforementioned theoretical predictions regarding the amygdala's role in dreaming. Generally, the only patients who regularly have brain damage specifically localised to the amygdala bilaterally are patients with an extremely rare genetic condition known as Urbach-Wiethe Disease (UWD) or Lipoid Proteinosis. Less than 300 cases of UWD have been reported in the world literature since Urbach and Wiethe first described the condition in 1929 (Cote, 1998; Thornton et al., 2008). UWD is caused by a mutation of the ECMI gene (Claeys et al., 2007). Given that this genetic mutation has been mapped, UWD is diagnosed using a genetic test that searches for this particular mutation. A group of about 30 patients living in small, rural communities in an area known as Namaqualand in the Northern Cape Province of South Africa constitute the largest known population of UWD patients anywhere in the world (Van Hougenhouck-Tulleken et al., 2004).

Despite there being a fair amount of clinical variation among UWD patients, the most striking symptoms typically arise from protein deposits that form small lumps on the skin and vocal chords, the latter resulting in a hoarse voice (Appenzeller et al., 2006; Claeys et al., 2007; Cote, 1998). In addition, symmetrical bilateral damage to the medial temporal lobes exists in more than half of all patients diagnosed with UWD. Most often this damage affects the amygdala, although in some cases it also spreads to surrounding brain structures. The calcifications generally develop over time, and the extent to which damage progresses is highly variable (Siebert et al., 2003; Thornton et al., 2008). Most of the UWD patients living in Namaqualand have brain damage that is localised specifically to the basolateral amygdala bilaterally. Another common neurological symptom of UWD is epilepsy (Claeys et al., 2007).

Research with UWD Patients

Investigating the cognition, affect, and behaviour of UWD patients (assuming that MRI scanning has confirmed amygdala calcification) provides a unique opportunity to answer questions about amygdala function. Many researchers have done exactly this, and much of what is recognized about the effects of amygdala dysfunction (see above) is based on such

studies. Probably the most well-known example of research with UWD patients is the detailed study of the patient SM, who has complete amygdala lesions due to UWD. Since the publication 20 years ago of their influential paper on SM's impaired recognition of emotion facial expressions (Adolphs et al., 1994), Adolphs and his colleagues have published many more papers on this patient's affective functioning.

However, a heavy reliance on single case studies and small sample sizes in studies with UWD patients, along with the varying degrees of amygdala damage in different patients, detracts from the generalizability of this literature. Given this history, the size of the UWD population living in Namaqualand, South Africa is exceptional in its potential to significantly impact the field of amygdala lesion research.

Dreaming in UWD Patients

To date, the only published literature involving the dreams of UWD patients is Wiest and Brainin (2010)'s neuropsychoanalytic study of a single UWD patient, which reported that the patient did indeed dream. No systematic investigation into the dreaming of UWD patients exists, yet studying these patients can clearly shed light on the role of the amygdala in dreaming. Studying UWD patients also provides an ideal opportunity to test the idea that the amygdala is involved in the affective formation of dreams, as well as some of the claims central to Revonsuo's TST.

Domhoff (2001) specifically recommended that the dreams of patients with damaged amygdalae be studied, hypothesising that such dreams would show a significantly lower proportion of negative emotion relative to positive emotion than the dreams of healthy individuals. Two previous student projects at the University of Cape Town (Denny, 2011; Koopowitz, 2012; both unpublished) have attempted such investigations; however, due to a number of methodological shortcomings, these studies failed to generate any significant results.

Pilot Research. The present study's preliminary findings (submitted as an Honours dissertation at the University of Cape Town) also found no significant differences between the dream reports of UWD patients and those of a matched control group. Qualitatively, however, the UWD patients' dream reports did seem to differ somewhat from the dream reports of the control participants. As might be expected, many of the UWD patients' dream reports did appear to be less unpleasant than the control dream reports. More surprisingly, many of the UWD patients' dream reports seemed to be very simple, wish-fulfilling dreams. These dream reports seemed devoid of the anxious and bizarre distortions that Freud

(1900/1954) conceptualized as ‘censorship’ in the dreams of normal adults. Given prevailing ideas about the amygdala’s role in anxiety, it is possible to speculate that basolateral amygdala damage could result in a decrease in these anxious reactions, and hence, lead to dreams which are on average more wish-fulfilling than is normal.

Given these qualitative observations (as well as the literature reviewed above), it is highly possible that the pilot research was unable to discover statistical significance due to methodological issues, and not because there are in fact no differences between the dreams of UWD patients and the dreams of healthy controls. Indeed, the pilot research was influenced by a number of methodological shortcomings, including; small sample size, insufficient contextual information to properly code the dream reports, problems with the measurement techniques, and problems with the statistical analyses.

In addition, it seems that the dream reports used in the pilot studies were inadequately extracted from the interviews as a whole. That is to say, some information that may have aided in the understanding of the dream reports was not included, and some irrelevant information (which appeared to be part of the dream reports) was included, which would have hampered accurate coding of the dreams. In addition, all of the dreams were reported in Afrikaans, and part of the problem may have been that the preparation of the dream reports for analysis was done by students who were not fluent in Afrikaans.

Various dream researchers, including Colace (2010), have argued that background information about a dreamer’s waking life is necessary in order to accurately interpret their dream reports. This was lacking in the pilot research.

Conceptualising the amygdala’s role in dreaming. In summary, the existing literature suggests that the amygdala may play an important role in dreaming, but this claim is based on very limited direct empirical evidence. Unpublished pilot research has failed to find significant differences between UWD patients’ dreams and the dreams of control participants, but this is difficult to interpret due to methodological issues such as small sample size, measurement difficulties, and inadequate statistical analyses. Building on the lessons learnt in the preliminary research, it is now possible to conduct a more extensive and rigorous investigation of the basolateral amygdala’s role in dreaming.

Rationale for the Present Research

As demonstrated in the above literature review, very little published empirical research regarding the amygdala’s role in dreaming exists, and none exists regarding the effects of bilateral amygdala damage on dreaming. Nevertheless, according to several dream theorists,

this structure may potentially play an important role in dreaming, particularly in the generation of affective dream plots. Indeed, some dream theories (particularly Revonsuo's) seem to be heavily reliant on assumptions regarding the amygdala's function in dreaming, and yet these claims are essentially untested.

The presence of a relatively large community of UWD patients living in the Northern Cape Province of South Africa provides a unique opportunity to address this knowledge gap and test these theories. Most of these patients have brain lesions localised specifically to the basolateral amygdala bilaterally. Not only is the specificity of damage to this particular brain area very rare, the size of this particular clinical population is unprecedented.

An extensive empirical examination of dreaming in this patient population would provide the first clear picture of the effects of bilateral basolateral amygdala damage on dreaming, and would thereby begin to address the paucity of scientific evidence regarding the amygdala's role in dreaming. Such evidence may in turn prove highly informative to the field of dream theory. A large, rigorous investigation is therefore required, and such research needs to circumvent the methodological problems previously encountered.

CHAPTER 2 - SPECIFIC AIMS AND HYPOTHESES

The central aim of the present study was to examine, as broadly as possible, the formal characteristics of relative aspects of dreaming in patients with UWD. I aimed to achieve this by collecting dream reports from UWD patients and a group of matched healthy controls, which three research assistants subsequently rated on a number of measures designed to investigate the theoretically relevant aspects of dreaming. The ultimate goal was to determine, with as much confidence as possible, whether there were any significant differences, on any of these measures, between the dreams of patients with UWD and those of matched healthy controls. Specifically, I aimed to test the common idea that the amygdala plays a role in the development of dream plots, and in the intensity of negative (particularly threat related) emotional experiences in dreams, and possibly in affective dream experiences more generally.

In order to achieve this degree of confidence in the results, this study built on the methodological experience gained by preliminary research. I therefore aimed to not only collect a larger sample of dream reports than I and the other UCT students were previously able to do, but also to collect background information about the research participants. I then aimed to present this to the research assistants as clearly, accurately, and completely as possible. Furthermore, I aimed to systematically review and refine all the dream coding measures developed by these students prior to the analysis of the dream reports.

Given that no previously published investigation into the effects of amygdala damage on dreams exists, and that the preliminary student research returned results of limited reliability, there was a restricted basis on which to form specific directional hypotheses. Therefore, the central hypothesis was simply *that the dream reports of UWD patients would differ significantly to the dream reports of control participants on at least some of the theoretically relevant measures tested*. The formal dream characteristics assessed by each of these measures, as well as a brief reminder of the rationale for their inclusion, are presented below.

1. The intensity of positive and negative affect in the dream report. The literature reviewed above presents significant theoretical and empirical grounds to suppose that the amygdala could play a role in the generation of intense negative emotion in dreams. The amygdala apparently also plays a role in positive emotional processes, although the nature of this role is less clear. This measure therefore aimed to assess the role of the basolateral amygdala in the generation of positive and negative dream affect.

2. Panksepp's seven basic emotions in the dream report. Research regarding the amygdala's waking function has suggested that the structure might be particularly involved in FEAR and RAGE processes. However, some research has also suggested that the amygdala may be involved in affective processes more generally. This study therefore aimed to assess the intensity of each of Panksepp's basic emotions in order to provide a broad understanding of the effects of bilateral basolateral amygdalae damage on dream affect.
3. The extent to which the dream report constituted the fulfilment of a wish. Based on the qualitative observations made in preliminary research, the present study aimed to assess whether the bilateral basolateral amygdala plays a role in wish fulfilment in dreams.
4. Whether the dream report could be classified as a nightmare. If patients with basolateral amygdala damage experience decreased negative emotions in their dreams, it may follow that they experience fewer nightmares. Furthermore, dream theorists have suggested that the amygdala plays a role in the generation of nightmares. Therefore, the current study aimed to test whether bilateral basolateral amygdala damage had any impact on the occurrence of nightmares.
5. The content analysis of bizarre elements in the dream report. De Genarro et al. (2011) found that reduced amygdala volume and structural integrity led to an increase in dream bizarreness. However, my initial qualitative observations in my preliminary research suggested that UWD patients' dream reports were generally relatively simple and non-bizarre. This study therefore aimed to gain a clearer understanding on the amygdala's possible role in dream bizarreness.
6. The word and narrative item count of the dream report. The literature provides some support for the idea that amygdala is involved in the generation of dream plots. Qualitatively, in my preliminary studies, it seemed that the UWD patients' dream reports were indeed shorter than control participants' dream reports. The present study therefore aimed to test this observation statistically, and also to determine whether the shorter dream reports were reflective of less narratively-complex dreams.
7. The incidence of threat and escape in the dream report. Revonsuo's (2000) TST would predict that patients with amygdala damage will exhibit fewer instances of threat and escape in their dreams. This study therefore aimed to test whether or not TST's predictions regarding the amygdala's role in threat-related dream activity hold true.
8. The incidence of approach versus avoidance behaviour in the dream report. Threat simulation theory views threat-avoidance behaviours as the cornerstone of dream behaviour, and the amygdala as being responsible for these behaviours (Revonsuo, 2000).

Approach behaviour, which is associated with the SEEKING system, provides a good contrast to threat-avoidance behaviour, which is associated with the FEAR system. This study therefore aimed to assess whether, in line with TST, patients with bilateral basolateral amygdala damage will display lower incidence of avoidance behaviour (relative to approach behaviour) than healthy individuals.

Based on the literature and preliminary observations mentioned above, a number of more specific, directional hypotheses were formed, namely.

1. *The dreams of patients with UWD will show a significantly lower mean degree of negative emotion than the dreams of control participants.*
2. *The dreams of patients with UWD will show a significantly lower mean degree of FEAR than the dreams of control participants.*
3. *The dreams of patients with UWD will show a significantly lower mean degree of RAGE than the dreams of control participants.*
4. *The dreams of patients with UWD will show a significantly higher mean degree of wish fulfilment than the dreams of control participants.*
5. *Significantly fewer of the UWD patient's dreams than the control participants' dreams will be classified as nightmares.*
6. *The dreams of patients with UWD will have a significantly lower word count than the dreams of control participants.*
7. *The dreams of patients with UWD will have a significantly lower narrative item count than the dreams of control participants.*

In addition, this study also set out to test the following hypotheses generated by Revonsuo's TST:

1. *There will be significantly fewer instances of threat in the dreams of patients with UWD than in the dreams of control participants.*
2. *Patients with UWD will successfully escape significantly fewer of the threats in their dreams than the control participants.*
3. *The dreams of patients with UWD will show significantly fewer instances of avoidance behaviour than the dreams of control participants.*

Due to the limitations of the existing evidence, I did not make specific predictions regarding the effect of bilateral basolateral amygdala damage on: the intensity of positive affect; the intensity of Panksepps' remaining five basic emotions; or the prevalence of bizarre elements in the dream reports.

CHAPTER 3 - METHODS

Design and Setting

This was a multi-method, quasi-experimental study examining the relationship between amygdala damage (the independent variable) and dream form and content (the dependent variable). To achieve this, the dreams of participants with UWD were compared to those of healthy controls on a variety of measures.

The study consisted of three major stages, namely the preliminary stage, during which I re-examined data collected during pilot research and refined various measures; the data collection stage, during which an intermediary collected new dream reports, and the data coding stage, during which research assistants coded the dream reports on the various measures. The preliminary stage and the data analysis stage took place in the Psychology Department at the University of Cape Town (UCT), and the data collection stage took place in the Namaqualand region of the Northern Cape.

Sample

The sample comprised eight UWD patients and seventeen matched, healthy controls. Six of the UWD patients were recruited for the initial stages of this project in 2011, and two of them were newly recruited in 2013. The inclusion criteria for the UWD group were a diagnosis of UWD (based on genetic tests and the presence of standard symptoms of UWD), and the presence of bilateral basolateral amygdala lesions, as confirmed by MRI (see APPENDIX A). There was a certain degree of homogeneity amongst the UWD participants in that, due to factors of geographical isolation, they all came from similar communities in Namaqualand, near Springbok in the Northern Cape Province of South Africa. They were all coloured[1], Afrikaans speaking individuals, who were of low socio-economic status, and had low-to-average IQ scores. The control group for this study comprised 17 healthy individuals who were living in the same communities as the UWD patients, and who were matched on all demographic measures.

Exclusion criteria for this study were: being younger than 18 years, having a history of alcoholism, having an IQ of less than 70, and having any psychiatric or neurological diagnoses apart from UWD. Children were excluded because the amygdala lesions associated

[1] This is a conventional term in South Africa to describe individuals of mixed race. It does not carry the same offensive connotations it does elsewhere in the world.

with UWD are usually only fully developed by adulthood (Siebert et al., 2003). Furthermore, dreaming probably depends at least in part on forebrain structures that are not yet fully developed in childhood, and children's dreams have been shown to be significantly different to the dreams of adults (Domhoff, 2001). Alcohol abuse was also used as an exclusion criterion, as alcohol can significantly damage various brain structures, especially the frontal lobes and the diencephalon, which leads to functional impairments most notable in memory processes. This could obviously impair dream recall (Moselhy, Georgiou, & Kahn, 2001). In addition, alcohol abuse has also been shown to effect sleeping patterns and can lead to sleep disorders (Roehrs & Roth, 2001).

Although ten UWD participants had originally been recruited at the outset of this project, two male UWD patients had to be excluded due to alcoholism. Alcoholism is widespread in the rural Northern Cape communities where these patients live, especially among the men. In addition, one of the female patients had to be excluded due to extensive brain lesions beyond the basolateral amygdalae, as well as a diagnosis of post-traumatic stress disorder. Another patient had to be excluded due to a diagnosis of clinical depression and nightly use of sleeping medications, which left her unable to recall dreams. This brought the original sample of UWD patients down to six participants.

Due to improved recruitment opportunities in 2013, two new female UWD patients were included. The final UWD patient group therefore comprised eight female patients, between the ages of 28 and 65 (M = 41.63, SD = 11.90) who had FSIQ scores ranging between 73 and 98 (M = 84.88, SD = 7.24). Despite the differences in age between the patients, and the potentially progressive nature of the medial temporal calcifications in UWD, all of them had circumscribed damage limited to the basolateral nuclei of the amygdala bilaterally. The control group comprised 17 women between the ages of 23 and 70 (M = 40.76, SD = 12.57), who had FSIQ scores ranging between 80 and 100 (M = 85.88, SD = 5.10).

Materials

The following materials were utilised.

FSIQ

An abbreviated version of the Full Scale IQ test was used to assess the participants' IQs. This version has previously been shown to be reliable amongst this specific population.

The Most Recent Dream (MRD) Method

Due to the geographical isolation of the patients being investigated, it was deemed too difficult to bring the participants to a sleep laboratory. Dream reports were therefore collected in the participants' homes, using the MRD method of dream report collection. The MRD is a viable alternative to collecting dreams in a laboratory (Domhoff, 2000). The MRD method asks the participants to recall the most recent dream that they can remember having, no matter how long ago the dream actually occurred (Avila-White, Schneider, & Domhoff, 1999). Participants are asked to pay attention to details such as settings, characters, and emotions (see APPENDIX B).

Coding Measures

Various coding measures were used to analyse the dream reports. A short description of each of these measures is provided below, and they are explained in more detail in the coding instructions provided in APPENDIX C.

The positive and negative affect scale. This scale was created for the purposes of the present study, and is based on the affective dream scale (see below). It was designed to measure the intensity of positive affect (characterised as all pleasant emotion) and negative affect (characterised as all negative emotion) in the dreams reports. It uses the same 0-3 scale as the ADS, where 0 = these emotions were absent; 1 = very little of these emotions were present; 2 = a moderate amount of these emotions were present; and 3 = these emotions were very intense. The positive and negative affect scale was tested and refined during the pilot stages of the study.

The affective dream scale (ADS). This scale has been successfully used to assess basic emotions in dreams in previous research in the Psychology Department at UCT (D. Wainstein, personal communication, August 31, 2012). The ADS has been developed and validated over the course of a number of projects in the UCT psychology department. The scale measures the intensity of the seven basic emotion systems, as identified by Panksepp (1998), on the 0-3 scale described above. These basic emotions are FEAR, SEEKING, RAGE, GRIEF, PLAY, LUST and CARE.

The wish-fulfilment scale. This scale measured to what extent each dream report constituted the fulfilment of a wish, and was also developed and refined during the pilot stages of the present study. It uses a similar 0-3 scale to the ADS, although in this case 0 = this dream includes no wish-fulfilling elements; 1 = this dream has some elements of wish fulfilment but is predominantly not a wish fulfilling dream; 2 = this dream includes a clear

wish-fulfilment but also includes other aspects; and 3 = this dream is completely wish-fulfilling.

Incidence of nightmares. This measure was included in order to investigate whether there was a difference between the frequencies of nightmares experienced by the UWD patients versus the controls. The incidence of nightmares was recorded by simply asking the research assistants to make a nominal judgement of whether or not the dream report in question could be labelled a nightmare. They were asked to make this decision based on a common-sense understanding of what nightmares are, and were provided with the following description in order to aid their decision: 'Nightmares are dreams marked by intensified feelings of dread or terror or other highly disturbing or unpleasant emotions, often with vivid visual imagery, these feelings are so intense that they typically cause the individual to wake up'. Given that there has been a general failure in the nightmare literature to agree on a single definition of the term, the description provided to the raters consisted of a combination of a number of influential definitions (Levin et al., 2010; Nielsen, 2005).

The content analysis of bizarre elements in dreams. Bizarreness in the dream reports was measured using Revonsuo and Salmivalli's (1995) method for the content analysis of bizarre elements in dreams. This scale has been shown to have high reliability and is believed to be more sensitive to various different types of bizarreness than previous scales have been (Revonsuo & Salmivalli, 1995; Revonsuo and Tarkko, 2002). This is a nominal coding system that requires raters to first identify all the content elements in each dream report (i.e. all the selves, places, times, persons, animals, body parts, plants, objects, events, actions, language, cognitions, emotions and sensations). The raters then determined whether each content element was non-bizarre, distorted, exotic, impossible, vague or discontinuous. Definitions of each of these categories are given in APPENDIX C.

Word and narrative item count. These two measures were developed and successfully utilised for the purpose of previous dream research in the UCT Psychology Department (Y. Gartner, personal communication, May 31, 2013), and were adapted slightly for the present study. This particular method was chosen as it has demonstrated very high inter-rater reliability, provided raters spend some time practising coding before the actual analysis. Basically, these scales require raters to count the number of words and the number of narrative items in the dream reports, thereby providing a measure of the length and narrative complexity of the dream reports. As well as being applied to the 84 dream reports, these measures were also applied to a sample of fifteen 'happy memories', which were analysed for the purpose of providing a comparison to the dream reports.

Incidence of threat and escape. This measurement was included in order to test predictions based on Revonsuo's (2000) TST of dreaming. The method used was the same as was effectively applied by Malcolm-Smith and Solms (2004), and Malcolm-Smith et al. (2008). This method involves asking the raters to make a series of five judgements concerning the presence and nature of threat and escape in each dream report.

Classification of approach versus avoidance behaviour. This method was employed by Malcolm-Smith et al. (2012) in order to test another aspect of TST. It provides a manner of assessing the prevalence of threat-avoidance behaviours in dream reports by contrasting the incidence of threat-avoidance to the incidence of a comparable instinctual-emotional behaviour, namely approach behaviour. 'Avoidance' behaviour was defined as, "the main activity of the subject of the dream is an attempt to avoid something through fleeing, freezing, hiding or the like"; and approach behaviour was defined as, "the main action of the subject of the dream is an attempt to approach something through engagement, exploration, curiosity or the like" (Malcolm-Smith et al., 2012, p. 409).

Research Team

Intermediary

All contact with the research participants was undertaken through Sister M, a first-language Afrikaans speaking nurse from a similar cultural background to the participants, who had worked extensively with these UWD patients (as well as the control participants) for the purposes of previous research. Although I can speak Afrikaans myself, it was especially important that the UWD patients speak to an interviewer with whom they felt comfortable, as they can be quite self-conscious about their skin and voice problems.

Research Assistants

Three research assistants coded all of the dream reports. These assistants remained blind to both the study's hypotheses and the patients' diagnoses. They all held Honours degrees in Psychology from UCT, and were first-language Afrikaans speakers.

Procedure

Preliminary Stage

During the pilot research, 16 dream reports from eight UWD patients, and 24 dream reports from 17 controls were analysed. The first stage of the present study focused on re-examining these participants and their dream reports. This was done in order to ensure that the dream

reports analysed in the present study were as accurate and informative as possible. It was discovered that two of the UWD patients were unsuitable for inclusion in the present study (see above), and the three dream reports that had been collected from these two patients were discarded (thus leaving 13 dream reports collected from six UWD patients). Two new UWD patients were recruited in their place.

Many of the previously collected dream reports had been collected as part of a more comprehensive interview, which was conducted for the purposes of other student research. These interviews were now inspected for any relevant personal, social or environmental information that could aid in coding the dream reports. In addition, Sister M was asked to provide relevant information that she felt would aid in the coding of the dream reports. For example, where a participant mentioned a daughter in a dream, Sister M informed us that the child in question was disabled. Therefore, the word 'my [disabled] daughter' was inserted into the relevant report.

During these more comprehensive interviews, six of the UWD patients and sixteen of the controls were also specifically asked to report a nightmare in addition to a normal dream report (the remaining two UWD patients and one control were never specifically asked about nightmares). These nightmares were collected for the purposes of a different study, which is why not all of this study's participants were systematically asked this question. However, the decision was made to include these nightmares in aspects of this study's analyses, as excluding them completely could potentially have led to erroneous conclusions. For example, it might have been concluded that the UWD patients did not have nightmares, when in fact nightmares had been recorded for the specific purposes of another study.

The remaining dream reports were then prepared for coding. It appears that in the preliminary studies mentioned above, the dream reports given to the research assistants were poorly extracted from the interview as a whole. All of the dream reports were therefore rewritten, ensuring that they were clearly presented, that all available information that might aid the coding process was included, and that all verbalisation that was not part of the dream report was excluded. Any additional relevant information that had been uncovered from the interviews, or had been provided by sister M, was incorporated into the dream reports in parentheses.

Lastly, the coding measures used by the pilot studies to analyse the dream reports were re-examined and modified based on any difficulties encountered in the pilot studies.

Data Collection Stage

During this stage, new dream reports were collected in the participants' homes through a structured clinical interview conducted by Sister M. The interview began by Sister M explaining that she was visiting them for the purposes of collecting a dream report, and asking them whether they knew what a dream was and whether they were currently dreaming. She then proceeded to ask them to report a dream, using the MRD method instructions. Though it is customary to collect a written MRD report, some of the study participants were not fully literate. For this reason, all the reports were collected orally, recorded on a voice recorder, and subsequently transcribed by myself.

In this manner, thirteen new dream reports were collected from the UWD disease patients, and 27 new dream reports were collected from control participants. The transcribed dream reports were then prepared for coding in the same manner as the dream reports that had been collected previously. This provided a total of 26 dream reports collected from eight UWD patients, and 58 dream reports collected from seventeen control participants.

Data Coding Stage

The research assistants coded the dream reports (which I presented to them in a random order) using the measures outlined under 'Materials' (see above). The full coding instructions given to the assistants are available in APPENDIX C.

The research assistants worked individually for most of the measures, although two measures were coded by consensus. For each measure, the assistants were trained to ensure that they were all coding in the same manner. To this end, they were given a set of ten practice dreams to code. These practice dreams were taken from an on-line dream database (http://www.dreambank.net).

For the measures that were coded individually, inter-rater reliability was calculated. For the categorical measures (i.e. the nightmare, bizarreness, threat and approach/avoidance coding), Domhoff's (1996) percentage of perfect agreement was used. Domhoff (1996) recommends the use of this stringent measure of inter-rater reliability for nominal coding in dream research, and argues that other measures of inter-rater reliability are inappropriate for such coding. Intra-class correlation coefficients (ICCs) were calculated for the continuous measures (i.e. the affect and wish fulfilment scales and the word and narrative item counts). This measure of inter-rater reliability is commonly used for ordinal data and has consistently been recommended by statisticians for psychological research (Hallgren, 2012). Specifically, two-way absolute agreement average-measures ICCs were calculated. For each coding

measure, a minimum inter-rater reliability of either 80% perfect agreement or *ICC* = .8 was achieved on the practice dreams before the raters began coding the dream reports collected from the research participants. If the raters did not achieve the minimum inter-rater reliability on the first set of ten practice dreams, they kept coding new sets of practice dreams until they were able to reach the required level of inter-rater reliability. The raters then moved onto coding the actual dream reports and happy memories, and once this was complete inter-rater reliability was checked once again. If the inter-rater reliability had fallen below 80% perfect agreement or *ICC* = .8 for the analyses of the actual reports, the raters coding decisions were re-examined in order to determine for which reports their decisions had differed most severely from one another. The offending reports were then recoded by consensus among the three research assistants.

The ADS and the bizarreness measure were coded by consensus due to the complicated and subjective nature of the judgements that these scales required. It was foreseen that the research assistants would not be able to achieve the desired 80% perfect agreement if they coded these measures individually. Prior to the main coding, the raters still coded ten practice dreams for these two measures. It was ensured that the raters were, through discussion, able to agree on 100% of the decisions made.

The word and narrative item count scales were also applied to 15 ‘happy memories’, which were collected orally from a subset of the participants. Eight happy memories were collected from control participants, and seven from the UWD patients. These happy memories were originally collected alongside sad, angry and scary memories during an interview conducted for the purposes of another study. These happy memories constituted narratives that were most readily comparable to dream narratives. (The happy memories were used, as opposed to the sad, angry or scary memories, as not all the participants were able to recall a sad, angry or scary memory. The happy memories therefore provided the biggest possible sample size of alternative narratives to compare to the dream reports.) The happy memories were subjected to a word and narrative item count in order to provide a comparison to the word and narrative item counts of the dream reports. It was hoped that this would illuminate whether any between-group differences in the length and narrative complexity of the dream reports were unique to dreams, or whether similar types of differences could be observed in the length and narrative complexity of a different type of report.

Ethical Considerations

Ethical approval for this study had already been granted prior to its commencement, as it formed part of an ongoing research project. The original ethical approval was obtained by Dr. Barak Morgan from Stellenbosch University (see APPENDIX D). This broader research project incorporates various studies, all examining UWD patients.

During the collection of the dream reports, each participant was read a copy of the Participant Information Sheet (which doubled as an informed consent form). This form explained the purpose of the study and highlighted that participation was entirely voluntary, that the participants could withdraw at any time, and that any information that they provided would be kept entirely confidential. An English translation of the Afrikaans sheet is attached (see APPENDIX E). No potential harm was foreseen for the participants who took part in this study. Nonetheless, debriefing and counselling were made available to the participants. Given that the interviews were conducted by sister M (who the participants were comfortable and familiar with), she was able to help the participants with any issues that came up during their interview. She was also available for the participants to contact at any stage.

Data Analysis

All statistics were conducted on SPSS version 21 and 22, or R version 3.0.1. Both continuous data (collected using the affect and wish-fulfilment scales, as well as the word and narrative item counts) and categorical data (the classification of bizarre dream elements; the incidence of nightmares, threat and escape; and the classification of approach versus avoidance behaviour) were descriptively and inferentially analysed. The UWD patient group was compared to the control group on each of these measures. All statistical analyses were run both with and without the specially requested ‘nightmares’ (see ‘Procedure’ section for an explanation) in order to determine whether this would produce different results. There were no instances in any of the analyses where excluding the ‘nightmares’ meant the difference between a significant and a non-significant result.

Given that three to four dream reports were collected from each participant, there was a possibility that dreams from the same participant may have been related to each other in some way. This would threaten assumption of independence of data – which is critical to the reliability of the statistical analyses run. Therefore, a multilevel modelling approach was used to determine whether significant variation existed between the different participants. However, in each analysis that was run, it was found that there was no significant variation at

the participant level. It was therefore not necessary to continue with a multilevel modelling approach and it was possible to treat the data as independent (Bliese, 2013).

Continuous Data

The continuous data was analysed by means of independent samples *t*-tests that compared the UWD patients' scores to the controls' scores on the various measures. For the intensity of positive and negative affect, Panksepp's seven basic emotions, and one of the word count analyses, the data was not normally distributed and Mann-Whitney tests were therefore performed instead of *t*-tests. Means and standard deviations were calculated for all tests, and for the non-parametric tests medians and range were also calculated. Pearson's correlation coefficient (*r*) was calculated in order to provide a measure of the effect size. The reported effect size is positive where it reflects a higher score for the UWD patients than the control participants, and negative where it reflects a lower score for the UWD patients than the control participants.

Categorical Data

The categorical data was analysed by means of Pearson's chi-square tests of contingency that compared the UWD patients' data to the control groups' data. Cramer's *V* and the odds-ratio were calculated in order to measure effect size. Once again, a positive Cramer's *V* reflects that the characteristic in question is more common among the UWD patients' dream reports than the control dream reports, and a negative Cramer's *V* reflects that the characteristic is less common among the UWD patients' dream reports. Standardised residuals and adjusted standardized residuals were analysed in order to determine the specific location of any effects.

Principal Components Analysis

In addition, I ran a principal components analysis with an oblique rotation in order to determine whether the large number of independent variables being measured could be reduced into a smaller number of common factors, thereby improving the understanding of the data. Mann-Whitney tests (chosen because the data was not normally distributed) were then used to compare the UWD patients' scores to the control participants' scores on the components that emerged.

CHAPTER 4 - RESULTS

Intensity of Positive and Negative Affect

Positive Affect

The inter-rater reliability criteria were met for this measure, as an excellent intra-class correlation (ICC) was achieved for the ten practice dreams, *ICC* = .98; as well as for the analysis of the actual dream reports collected from the study participants, *ICC* = .91. As is shown in Table 1, the UWD patients had a higher mean positive affect score than the control participants did. A one-tailed Mann-Whitney *U* test indicated that this difference was significant, $U = 475$, $p = .003$, $r = .30$.

Negative Affect

Inter-rater reliability, as measured by the ICC, was excellent for both the practice dream reports, *ICC* = .90; and for the study dream reports, *ICC* = .91. The UWD patients had a lower mean negative affect score than the control participants (see Table 1). A one-tailed Mann-Whitney *U* test indicated that UWD patients' dream reports showed a significantly lower degree of negative affect than the control participants' dream reports, in line with this study's hypothesis to that effect, $U = 571.5$, $p = .037$, $r = -.20$.

Table 1. *Descriptive Statistics: Positive and Negative Affect*

	Group	
Measure	UWD patients	Controls
Positive affect	1.47 (1.05)	0.80 (0.98)
	1.33 (3)	0.33 (3)
Negative affect	1.12 (0.97)	1.6 (1.11)
	1.17 (2.67)	2 (3)

Note. Means are presented with standard deviations in parentheses. Medians with range in parentheses are reported below given that a non-parametric test was run.

Panksepp's Seven Basic Emotions

Inter-rater reliability was not calculated for this measure, as it was coded by consensus. None of the reported dreams showed any instances of LUST, so this basic emotion was omitted from the analysis. As is seen in Table 2, no RAGE was observed in any of the UWD patients' dream reports, while on average a small amount was observed in the controls' dream reports.

This difference was significant, $U = 624$, $p = .019$, $r = -.24$, which is in line with this study's hypothesis that the UWD patients' dream reports would show a reduced degree of RAGE. Table 2 also shows that the UWD patients' dream reports had a higher mean PLAY score than the controls' dream reports, and this difference was also significant, $U = 603$, $p = .046$, $r = .19$. For all the other basic emotions, the controls' dream reports were found to have slightly higher means than the UWD patients' dream reports, but none of these differences were significant. This study therefore failed to confirm the hypothesis that the UWD patients' dream reports would show a significantly lower intensity of FEAR than the control participants' dream reports.

Table 2. *Descriptive Statistics: Basic Emotions*

	Group	
Emotion	UWD patients	Controls
RAGE	0 (0)	0.33 (0.803)
	0 (0)	0 (3)
FEAR	1.08 (1.23)	1.34 (1.358)
	1 (3)	1 (3)
GRIEF	0.46 (0.905)	0.57 (1.045)
	0 (3)	0 (3)
SEEKING	0.81 (0.939)	1.19 (1.206)
	0 (2)	1 (3)
PLAY	1.15 (1.377)	0.64 (1.087)
	0 (3)	0 (3)
CARE	0.69 (1.05)	0.97 (1.228)
	0 (3)	0 (3)

Note. Means are presented with standard deviations in parentheses. Medians with range in parentheses are reported below as non-parametric tests were run.

Wish Fulfilment

High ICCs were calculated for the practice dreams, *ICC* = .81; and the study dreams, *ICC* = .94. Table 3 shows that the UWD patients' dreams had a higher mean wish-fulfilment score than the controls' dreams did. In line with this study's hypothesis that the UWD patients' dream reports would show a higher degree of wish fulfilment, this difference was significant, $U = 511$, $p = .009$, $r = .26$.

Table 3. *Descriptive Statistics: Wish Fulfilment*

	Group	
Measure	UWD patients	Controls
Wish fulfilment	1.78 (1.03)	1.16 (1.09)
	2 (3)	0.83 (3)

Note. Means are presented with standard deviations in parentheses. Medians with range in parentheses are reported below as a non-parametric test was run.

Nightmares

Inter-rater reliability scores of 100% and 88% were achieved for the practice dreams and study dreams respectively, as calculated by Domhoff (1996)'s measure of perfect agreement. Table 4 indicates that 11.5% of the UWD patients' dream reports and 31% of the controls' dream reports were classified as nightmares. *Figure 2* provides a graphic indication of these differences.

Table 4. *Contingency Table: Nightmares*

	Nightmare	
Group	No	Yes
UWD	23 (88.5%)	3 (11.5%)
	.8 (1.9)	-1.4 (-1.9)
Control	40 (69%)	18 (31%)
	-.5 (-1.9)	.9 (1.9)

Note. Group frequencies are reported with group (row) percentages in parentheses. Standardized residuals with adjusted standardized residuals in parentheses are reported below.

A Pearson's chi-square test demonstrated a significant association between whether a dream report came from an UWD patient or from a control participant, and whether the report was classified as a nightmare or not, χ^2 (1) = 3.64, p = .047, ϕ_{Cramer} = .21. Calculating the odds ratio revealed that the chance of a control participant's dream report being a nightmare was 3.45 times higher than the chance of an UWD patient's report being a nightmare. Despite none of the standardized residuals being significant, the adjusted standardized residuals are very close to the significance level of ± 1.96 (see Table 4), suggesting that the observed counts are very nearly significantly different to the expected counts.

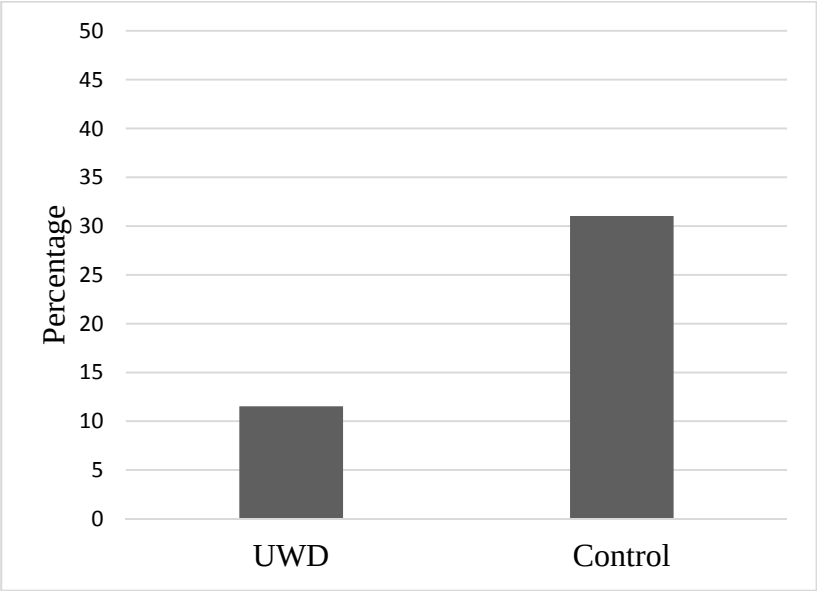

Figure 2. Percentage of the dream reports that were coded as nightmares.

'Nightmares' Collected from a Subset of the Participants

Six of the UWD patients, and fourteen controls, had been asked a series of questions specifically about nightmares. All six of the UWD patients asked said that they understood what a nightmare was, as did fourteen of the sixteen controls. Three of those six UWD patients said that they had had a nightmare before (50%) and twelve of the fourteen controls (86%) said that they had had a nightmare before. These three UWD patients all actually reported a 'nightmare' (although one of these 'nightmares' was not classified as a nightmare when the raters performed the nightmare coding), and so did six of the controls (the other five controls were unable to recall a nightmare at the time of the interview, despite saying that they had had a nightmare before). Therefore, nine 'nightmares' were collected in total (these are referred to in inverted commas because the 'nightmares' collected in this manner did not

necessarily meet the criteria to be classified as nightmares by the raters). A summary of the details of these 'nightmares' is presented in Table 5.

When these 'nightmares' were removed from the chi-square analysis of nightmare frequency, only one of the remaining 23 UWD patients' dream reports was classified as a nightmare, as were 12 of the remaining 52 controls' dream reports (as depicted in Table 6). The chi-square result remained similar, $\chi^2(1) = 3.90$, $p = .043$, $\phi_{Cramer} = .23$. However, as the expected count for one of the cells is smaller than five (see Table 6), the statistical power of the test may have been undermined, which could have resulted in an under-estimation of the chi-square statistic. For this reason, Fisher's exact test statistic has been reported.

The effect size, as measured by the odds ratio, increased notably. It seems that when the participants were simply asked to report a dream (as opposed to some of the participants specifically being asked to report a nightmare), the controls were 6.6 times more likely to report a nightmare than the UWD participants were. *Figure 3* provides a graphic representation of this difference. Furthermore, the adjusted residuals increased to above the significance level of ±1.96, indicating more definitively that for this test, the observed counts are significantly different to the expected counts. An analysis of the standardized residuals indicates where the difference lies, namely that fewer UWD patients than expected reported nightmares. The hypothesis that fewer of the UWD patients' dreams than control participants' dreams would be nightmares is therefore supported.

Table 5. *Summary of the Specifically Requested 'Nightmares'*

	Group	
	UWD patients	Controls
Total no. of participants	8	17
No. asked about nightmares	6	16
Understood nightmares	6	14
Had (ever) had a nightmare	3	12
Reported a 'nightmare'	3	6
Rated as a nightmare	2	6

Table 6. *Contingency Table without the Specifically Requested 'Nightmares'*

Group	Nightmare	
	No	Yes
UWD	22 (95.7%)	1 (4.3%)
	.7 (2.0)	-1.5 (-2.0)
Control	40 (76.9%)	12 (23.1%)
	-.5 (-2.0)	1.0 (2.0)

Note. Group frequencies are reported with group (row) percentages in parentheses. Standardized residuals with adjusted standardized residuals in parentheses are reported below.

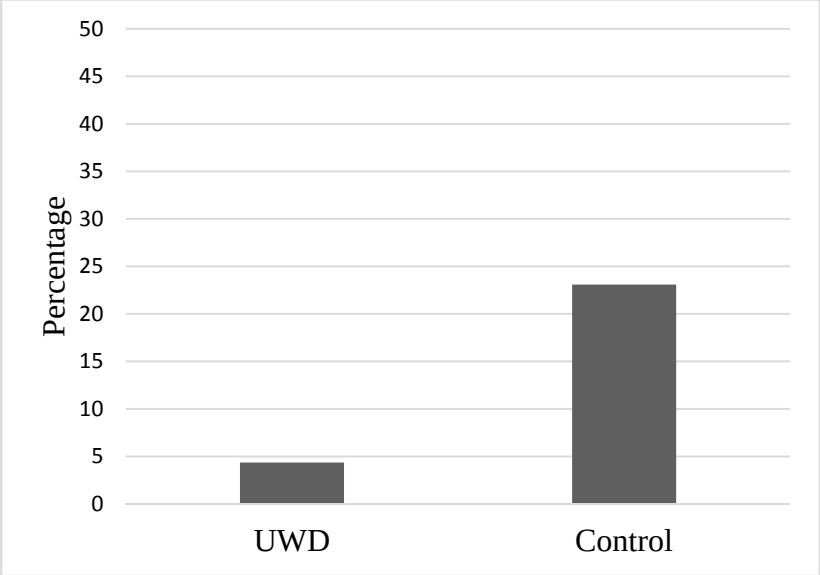

Figure 3. Percentage of the dream reports that were coded as nightmares when the specially requested 'nightmares' were removed.

Bizarreness

Given that this scale was coded by consensus, no measure of inter-rater reliability was calculated. A contingency table revealed very similar percentages of bizarre and non-bizarre elements across both of the study groups (see Table 7). A chi-square test produced a non-significant result.

When the bizarre elements were broken down into the different types of bizarreness, the frequencies of the different types of bizarreness were again quite similar across both groups (see Table 8). It is interesting to note though, that the standardised and adjusted standardised residuals for the incongruous elements were considerably larger than any of the

other residuals. Specifically, they seem to indicate that if there is any difference between the observed frequencies and the expected frequencies, that difference could be that there are fewer incongruous elements in the UWD patient dream reports than might be expected. However, the residuals (at -1.5 and -1.7) do not cross the -1.96 threshold of significance, and a chi-square test of contingency once again produced a non-significant result.

Table 7. *Contingency Table: Bizarreness*

	Type of element	
Group	Bizarre	Non-bizarre
UWD	58 (10.9%)	475 (89.1%)
	-.3 (-.4)	.1 (.4)
Control	180 (11.5%)	1388 (88.5%)
	.2 (.4)	-.1 (-.4)

Note. Group frequencies are reported with group (row) percentages in parentheses. Standardized residuals with adjusted standardized residuals in parentheses are reported below.

Table 8. *Contingency Table: Different Types of Bizarre Elements*

	Type of bizarre element		
Group	Incongruous	Vague	Discontinuous
UWD	21 (3.9%)	22 (4.1%)	16 (3%)
	-1.5 (-1.7)	.1 (.2)	.0 (.1)
Control	94 (5.9%)	63 (4.0%)	47 (3%)
	.8 (1.7)	-.1 (-.2)	.0 (-.1)

Note. Group frequencies are reported with group (row) percentages in parentheses. Percentages reflect percent of total within-group dream elements. Standardized residuals with adjusted standardized residuals in parentheses are reported below.

The incongruous elements can be further broken down into three different types (distorted, exotic and impossible). Table 9 indicates that the percentage of distorted elements across the two groups was again quite similar, and the percentage of exotic elements was in fact exactly the same. The only real difference seems to be between the percentage of

impossible elements, and the adjusted standardised residual of 1.9 is very close to significant, suggesting that the percentage of impossible elements in a dream report may be contingent on whether the dreamer is an UWD patient or not. The odds ratio revealed that a dream element in a control participant's dream report was 2.41 times more likely to be impossible than a dream element in an UWD patient's dream report. Furthermore, when only the bizarre elements were taken into account, the odds ratio showed that a bizarre element in a control participant's dream report was 2.56 times more likely to be impossible than a bizarre element in an UWD patient's dream report. However, the over-all chi-square test still produced an insignificant result.

Table 9. *Contingency Table: Different Types of Incongruous Elements*

	Type of incongruous element		
Group	Distorted	Exotic	Impossible
UWD	11 (2.1%)	5 (0.9%)	5 (0.9%)
	-.8 (-.9)	.0 (.0)	-1.6 (-1.9)
Control	44 (2.8%)	15 (0.9%)	35 (5.9%)
	.4 (.9)	.0 (.0)	.9 (1.9)

Note. Group frequencies are reported with group (row) percentages in parentheses. Percentages reflect percent of total within-group dream elements. Standardized residuals with adjusted standardized residuals in parentheses are reported below.

Word Count

Excellent ICCs of *ICC* = .91, and *ICC* = .96, were calculated for the practice and study dreams respectively. The word count scores were not normally distributed, and there was strong evidence of heteroscedasticity, $F(1,82) = 12.04$, $p = .001$. However, a log transformation was able to satisfactorily address both problems. A *t*-test on the transformed data indicated that the average word count of the UWD patients' dream reports (see Table 10) was significantly lower than that of the controls' dream reports, and the effect size was moderate, $t(82) = -3.28$, $p = .001$, $r = -.34$. This is in line with this study's hypothesis to this effect. When the 'nightmares' (which tended to be shorter reports) were omitted from the analysis, the difference between the average word count of the UWD patients' dream reports and the average count of the controls' dream reports increased, as is reflected by the smaller *p* value and larger effect size $t(73) = -3.58$, $p < .001$, $r = -.39$.

Table 10. *Descriptive Statistics: Word Count*

Data	Group	
	UWD patients	Controls
Raw scores	83.00 (63.67)	175.59 (151.82)
Without nightmares	86.54 (66.16)	189.75 (153.74)
Log transformed	1.77 (0.39)	2.08 (0.40)
Log transformed without nightmares	1.79 (0.40)	2.13 (0.38)

Note. Means are presented with standard deviations in parentheses.

Happy Memories Word Count

The ICC calculated for the happy memories did not meet this study's inter-rater reliability criteria, *ICC* = .76. Therefore, those happy memories which showed the greatest word count difference between raters were recoded by consensus. Although the data collected deviated significantly from the assumption of normality, it appeared to be homoscedastic, and therefore a Mann-Whitney *U* test is reported. The average word count for the UWD patients' happy memories was less than the average word count for the controls' happy memories (see Table 11); but despite the moderate effect size, this difference was not significant, $U = 16$, $z = -1.39$, $p = .095$, $r = -.36$. However, the non-significant *p* value should be interpreted with caution, as it could be a product of the small sample size as opposed to a true indication that there was no difference between the length of the UWD patients' and the control participants' dream reports. The moderately strong effect size also suggests that UWD does in fact have an impact on the length of the happy memories.

Table 11. *Descriptive Statistics: Happy Memories Word Count*

Measure	Group	
	UWD patients	Controls
Word count	36.90 (16.86)	115.75 (130.13)
	34.33 (49.67)	77.83 (387.33)

Note. Means are presented with standard deviations in parentheses. Medians with range in parentheses are reported below given that a non-parametric test was run.

Narrative Item Count

High ICCs of *ICC* = .87, and *ICC* = .95 were calculated for the practice and study dreams, respectively. Once again, the data was not normally distributed, and there was strong evidence of heteroscedasticity, $F(1,82) = 10.01$, $p = .002$. A logarithmic transformation was used to solve the problems of non-normality and heteroscedasticity. A *t*-test on the transformed data indicated that the average narrative count of the UWD patients' dream reports (see Table 12) was significantly lower than the average narrative count of the controls' dream reports, and the effect size was moderate, $t(82) = -2.35$, $p = .011$, $r = -.25$. Once again, this finding is in line with the corresponding hypothesis made by this study. Again, omitting the 'nightmares' from the analysis led to an increase in the difference between the average narrative count of the UWD patients' dream reports and the average count of the controls' dream reports, $t(73) = -2.60$, $p = .006$, $r = -.29$.

Table 12. *Descriptive Statistics: Narrative Count*

	Group	
Data	UWD patients	Controls
Raw scores	43.65 (26.68)	73.43 (57.83)
Without nightmares	45.65 (27.36)	78.99 (58.41)
Log transformed	1.55 (0.31)	1.74 (0.35)
Log transformed without nightmares	1.57 (0.31)	1.78 (0.33)

Note. Means are presented with standard deviations in parentheses.

Happy Memories Narrative Item Count

The happy memories' ICC score was only moderately strong, *ICC* = .66. Once again, those happy memories on which the raters had disagreed most severely were recoded by consensus. This data showed evidence of non-normality, as well as heteroscedasticity, $F(1,13) = 6.31$, $p = .026$. In this instance, the problem seemed to be best corrected by a reciprocal transformation. As with the word count, the mean narrative count for the UWD patients' happy memories was lower than the mean narrative count for the controls' happy memories (see Table 13). The effect size was moderate, although the difference was not significant, $t(13) = 1.46$, $p = .084$, $r = -.38$. Once again, this non-significant result should be interpreted with caution due to the small sample size, especially in light of the moderate effect size.

Table 13. *Descriptive Statistics: Happy Memories Narrative Count*

	Group	
Data	UWD patients	Controls
Raw scores	22.76 (9.95)	66.79 (72.91)
Reciprocally transformed	0.05 (0.02)	0.03 (0.03)

Note. Means are presented with standard deviations in parentheses.

Threat

For the threat and escape measure as a whole, perfect agreement of 91% and 82% were calculated for the practice dreams and study dreams respectively. A slightly higher percentage of the UWD patients' dream reports contained a significant physical threat to the dreamer (34.6%) relative to the controls' dream reports (27.6% - see Table 14). However, a chi-square test revealed that the incidence of threat in the dream reports was not significantly contingent on whether the dreamer was an UWD patient or not, χ^2 (1) = .42, p = .343, ϕ_{Cramer} = .07. The odds ratio showed that an UWD patients' dream report was 1.39 times more likely to contain a significant physical threat than a control participants' dream report. This contradicts the hypothesis that fewer of the UWD patients' dream reports would contain a significant threat to the dreamer than the controls' dream reports.

Table 14. *Contingency Table: Dream Reports Containing Threats*

	Did the dream report contain a threat?	
Group	No	Yes
UWD	17 (65.4%)	9 (34.6%)
	-.3 (-.7)	.5 (.7)
Control	42 (72.4%)	16 (27.6%)
	.2 (.7)	-.3 (-.7)

Note. Group frequencies are reported with group (row) percentages in parentheses. Standardized residuals with adjusted standardized residuals in parentheses are reported below.

It should be noted that in the subsequent analyses of whether the threat was life-threatening or not, whether the threat was ancestral or modern, whether the dreamer was able

to escape that threat or not, and whether that escape was realistic, each contingency table contained at least one cell with an expected count of less than five. The likelihood of coming to a false negative conclusion may therefore have been increased, and for this reason Fisher's exact test statistic has been reported.

In total, 22.2% of the threats experienced by the UWD patients were coded as life-threatening, compared to 75% of the threats experienced by the controls (see Table 15). A chi-square test yielded a significant result, suggesting that there was a significant relationship between whether a dreamer was an UWD patient or not, and whether the threat that they experienced in their dream was life-threatening, χ^2 (1) = 6.51, p = .016, ϕ_{Cramer} = .51. Examining the odds ratio revealed that a threat in a control participants' dream report was 10.5 times more likely to be life-threatening than a threat in an UWD patient dream report.

The vast majority of the threats experienced by both the UWD patients and the controls were ancestral as opposed to modern (88.9% for the UWD patients and 93.8% for the controls). A chi-square test produced a non-significant result.

Table 15. *Contingency Table: Life-threatening vs. Non-life-threatening Threats*

	Life-threatening	
Group	No	Yes
UWD	7 (77.8%)	2 (22.2%)
	1.5 (2.6)	-1.4 (-2.6)
Control	4 (25.0%)	12 (75.0%)
	-1.1 (-2.6)	1.0 (2.6)

Note. Group frequencies are reported with group (row) percentages in parentheses. Standardized residuals with adjusted standardized residuals in parentheses are reported below.

The percentage of UWD patients who were able to escape the threat in their dream reports (66.7%) was higher than that of the control participants (43.8%). However, a chi-square test revealed no significant relationship between whether the dreamer belonged to the patient group or the control group, and whether they were able to escape a threat in their dreams, χ^2 (1) = 1.21, p = .248, ϕ_{Cramer} = .22. The odds ratio showed that UWD patients were 2.58 times more likely than control participants to escape the threat in their dreams, contradicting the hypothesis that UWD patients would be less likely to escape the threats in

their dream reports than control participants. 33.3% of the UWD patients' escapes were realistic, as were 57.1% of the controls' escapes. A chi-square test once again produced a non-significant result.

In total, two of the 26 dream reports from UWD patients (7.7%), and four of the 58 dream reports from control participants (6.9%), contained a realistic physical threat to the dreamer and a subsequent realistic escape.

The difference in the instance of threat in the UWD patients' dream reports and the controls' dream reports diminished when the specifically requested 'nightmare' reports were removed. Six of the remaining 23 UWD patient dream reports contained a threat (26.1%), as did eleven of the remaining 52 control dream reports (21.2%). It is also interesting to note that three of the six remaining UWD dream reports containing threat came from participant number 30; in other words, all of the dream reports collected from this participant contained a significant physical threat.

Approach versus Avoidance Behaviour

The percentage of perfect agreement was calculated at 87% and 85% for the practice dreams and study dreams respectively. Both the UWD patients and the control participants showed considerably higher levels of approach behaviour versus avoidance behaviour in their dreams, and these rates were very similar across the two groups: 76.9% of UWD patients' dream reports, and 74.1% of controls' dream reports, were coded as involving predominantly approach behaviour. When the specifically requested 'nightmares' were removed from the analysis, the percentage of dreams that exhibited predominantly approach behaviour increased slightly across both groups: to 83.3% of the UWD patients' dream reports, and 80.8% of the controls' dream reports. Chi square analyses confirmed that there was no significant relationship between whether a dream came from an UWD patient or not and whether that dream constituted mostly approach or avoidance behaviour, contradicting the hypothesis that fewer of the UWD patients' dream reports would contain avoidance behaviour than control participants' dream reports.

Factor Analysis

The original principal components analysis was conducted on 16 variables, namely: positive affect; negative affect; six of Panksepp's basic emotions (LUST was omitted as a score of 0 was recorded for every dream); wish fulfilment; nightmares; threat; approach versus avoidance behaviour; the total number of non-bizarre elements; the total number of bizarre

elements; the narrative item count; and the word count. However, the solution was found to be more stable when RAGE, GRIEF and CARE were also excluded from the analysis. This was due to these variables explaining very little variance, having low correlations with the other variables, and therefore also relating poorly to the primary components extracted by the analysis. In addition, these variables scored poorly on the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy. This was especially true for RAGE, which had KMO = .44, which is below the acceptable threshold of .5 (Field, 2009).

When these three variables were removed, the KMO score for the analysis as a whole was good, KMO = .74. The individual KMO scores were all greater than >.59. Bartlett's test of sphericity was significant, χ^2 (78) = 945.64, $p < .001$, indicating that the correlations between the variables were sufficiently large for principal components analysis.

The correlation matrix for the remaining 13 variables, as well as for the 'bizarreness ratio' (a variable reflecting the percentage of the total bizarre and non-bizarre elements which were bizarre), is provided in Table 16. A number of very strong correlations are immediately apparent.

A principal components analysis with an oblique rotation (oblimin) on the 13 variables revealed a three-factor solution. This solution was based on Kaiser's criterion (all three factors had eigenvalues greater than one), as well as on the analysis of the scree plot (the point of inflection fell at the fourth component, indicating that the first three components should be retained). Together, these three components explained 74% of the variance. The loadings of each variable on the three components after rotation are reflected in the pattern matrix (see Table 17). The correlations between each variable and the three components are reflected in the structure matrix (see Table 18).

The clustering of the variables suggests that the first component constitutes an 'Unpleasantness' component, given that positive affect, PLAY, and wish fulfilment all have large negative loadings on this component, and the negative affect and nightmare variables load onto the component positively (see Table 17). The structure matrix reveals that FEAR also has a strong positive correlation with this component (see Table 18).

The second component seems chiefly to be a 'Length of the dream report' component, as word count, narrative count, and the number of non-bizarre elements load the most strongly onto this component, and each of these variables is chiefly a measure of how long the dream report is.

Table 16. *Correlation Matrix*

Variables	Variables						
	Pos. affect	Neg. affect	PLAY	FEAR	SEEKING	Wish fulfil.	Nightmare
Positive affect	1.00	**-.659***	**.882***	**-.524***	-.267	**.910***	**-.509***
Negative affect		1.00	**-.638***	**.729***	.442	**-.653***	**.574***
PLAY			1.00	-.461	-.245	**.749***	-.363
FEAR				1.00	.341	**-.514***	**.640***
SEEKING					1.00	-.241	.182
Wish fulfilment						1.00	**-.612***
Nightmare							1.00
Threat	-.341	.462	-.370	**.645***	.097	-.281	.286
Approach vs avoid.	.377	-.437	.363	-.451	-.109	.303	-.302
Non-bizarre elements	-.115	.398	-.148	.254	**.610***	-.098	.140
Bizarre elements	-.128	.249	-.122	.143	.342	-.162	.136
Word count	-.135	.357	-.149	.196	**.503***	-.112	.119
Narrative count	-.137	.407	-.138	.223	**.541***	-.099	.087
Bizarreness ratio	-.186	.027	-.145	.037	-.072	-.224	.102

Note. Correlations ≥ .5 are indicated by * and presented in bold.

Table 16. continued

Variables	Variables						
	Threat	App. avoid	Non-bizarre	Bizarre	Word count	Narr. count	Bizarre ratio
Threat	1.00	**-.707***	.145	.022	.087	.078	.065
Approach vs. avoid.		1.00	.045	-.049	.080	.059	-.135
Non-bizarre elements			1.00	.330	**.880***	**.907***	-.319
Bizarre elements				1.00	.386	.360	**.619***
Word count					1.00	**.916***	-.186
Narrative count						1.00	-.235
Bizarreness ratio							1.00

Note. Correlations ≥ .5 are indicated by * and presented in bold.

In addition, none of the variables load negatively onto the second component (see Table 17), although the correlations between positive affect, PLAY, wish fulfilment, and this length component are negative, though not very large (see Table 18). This strengthens the hypothesis that the second component is a 'Length' component, as it suggests that the count or intensity of most of the variables increases as the dream report gets longer (with the exception of positive affect PLAY, and wish fulfilment).

The third component can be viewed as a 'Danger' component. Both FEAR and threat have large positive loadings on this component, and approach versus avoidance behaviour has a strong negative loading on the component (given that avoidance behaviour was scored as 0, and approach behaviour as 1, this means that the higher a participant's score on the 'Danger' component, the more likely that her dream was to be classified as demonstrating chiefly avoidance behaviour versus being classified as demonstrating chiefly approach behaviour).

Table 17. *Pattern Matrix*

Variable	Component		
	Unpleasantness	Length	Danger
Positive affect	**-.975***	.033	.033
Negative affect	**.548***	.324	.328
PLAY	**-.866***	.004	-.006
FEAR	.326	.170	**.609***
SEEKING	.128	**.674***	.039
Wish fulfilment	**-.996***	.048	.092
Nightmare	**.580***	.022	.203
Threat	-.083	.023	**.954***
Approach vs. avoidance	-.028	.140	**-.854***
Non-bizarre elements	-.129	**.966***	.060
Bizarre elements	.111	.489	-.085
Word count	-.085	**.952***	-.030
Narrative count	-.103	**.969***	-.005

Note. Factor loadings ≥ .5 are indicated by * and presented in bold

Table 18. *Structure Matrix*

Variable	Component		
	Unpleasantness	Length	Danger
Positive affect	**-.953***	-.209	-.390
Negative affect	**.773***	**.501***	**.606***
PLAY	**-.866***	-.215	-.384
FEAR	**.635***	.325	.771
SEEKING	.315	**.711***	.175
Wish fulfilment	**-.944***	-.192	-.338
Nightmare	**.675***	.193	.460
Threat	.340	.116	**.921***
Approach vs. avoidance	-.366	.032	**-.851***
Non-bizarre elements	.141	**.941***	.119
Bizarre elements	.197	**.507***	.022
Word count	.142	**.927***	.046
Narrative count	.139	**.942***	.066

Note. Correlations ≥ .5 are indicated by * and presented in bold.

It is interesting to note that the total number of bizarre elements does not load very strongly onto any of these components (its strongest loading is on the 'Length' component). It could be argued that the percentage of elements in a dream that are bizarre is a better

measure of how bizarre a dream is than the total number of bizarre elements. Interestingly, when the variable 'bizarreness ratio' was added to the factor analysis, a fourth component emerged. Only two variables had loadings greater than .1 on this component, namely the total number of bizarre elements (with a factor loading of .871) and bizarreness ratio (with a factor loading of .913). This suggests that this fourth component is a 'bizarreness' component.

The 'Unpleasantness' Component

The control participants had a higher mean score on the 'unpleasantness' component than the UWD participants (see Table 19). A one-tailed Mann-Whitney *U* test revealed that this difference was significant, $U = 478$, $p = .004$, $r = -.29$.

Table 19. *Descriptive Statistics: 'Unpleasantness'*

	Group	
Component	UWD patients	Controls
'Unpleasantness'	-.40 (.97)	.18 (.97)
	-.34 (3.18)	.52 (3.19)

Note. Means are presented with standard deviations in parentheses. Medians with range in parentheses are reported below given that a non-parametric test was run.

The 'Length' Component

The control participants had a higher mean score on the 'length' component than the UWD participants (see Table 20). However, before further analysis took place, the data was inversely transformed in order to correct for severe heteroscedasticity. The subsequent one-tailed Mann-Whitney *U* test revealed that the difference between the groups was significant, $U = 555$, $p = .027$, $r = -.21$.

The 'Danger' Component

The UWD patients had a higher mean score on the 'danger' component than the control group (see Table 21). However, a one-tailed Mann-Whitney *U* test returned a non-significant result, $U = 672$, $p = .216$, $r = .09$.

Table 20. *Descriptive Statistics: 'Length'*

	Group	
Component	UWD patients	Controls
'Length'	-.39 (.58)	.18 (1.10)
	-.42 (2.22)	-.08 (4.30)
Inversely transformed	-1.91 (4.91)	9.53 (87.85)
'length'	-1.35 (24.13)	-.94 (741.81)

Note. Means are presented with standard deviations in parentheses. Medians with range in parentheses are reported below given that a non-parametric test was run.

Table 21. *Descriptive Statistics: 'Danger'*

	Group	
Component	UWD patients	Controls
'Danger'	.03 (.99)	-.01 (1.01)
	-.55 (.97)	-.42 (3.03)

Note. Means are presented with standard deviations in parentheses. Medians with range in parentheses are reported below given that a non-parametric test was run.

CHAPTER 5 - DISCUSSION

This study examined the difference between UWD patients' and control participants' scores on measures of various dream characteristics in order to investigate the role the basolateral amygdala plays in dreaming. Taken together, the results of these measures begin to characterise the dreams of Urbach-Wiethe Disease patients as being generally more pleasant, less unpleasant, more wish fulfilling, less likely to be nightmares, simpler and shorter than the dreams of control participants. Due to the very high inter-rater reliability scores for all the individually coded measures (with the exception of the happy memory counts), these results can be interpreted with considerable confidence.

This discussion will begin with a brief account of each of the individual results, before turning to how these findings might impact on some influential dream theories. As set out in the literature review, Solms (2000) does not place a great emphasis on the amygdala's role in dreaming, suggesting that the dopaminergic pathways of the SEEKING system constitute the critical structures. In contrast, Hobson et al. (2000) and Levin et al. (2010) suggest that the amygdala is central to the dreaming process, while Revonsuo (2000) contends that the very purpose of dreaming is the priming of the fear conditioning system that centres on the amygdala.

The Preservation of Dreaming and Dream Memory in UWD Patients

Firstly, confirming Wiest and Brainin's (2010) findings, this research proves that patients without functioning basolateral amygdalae are able to dream, and to remember their dreams. Therefore, despite high levels of activation during REM, and somewhat contrary to the ideas put forth by some theorists, the basolateral amygdala does not seem to be an indispensable structure in the production of dreams. The UWD patients were able to recall a dream on every occasion that they asked for a dream report. They did not struggle to recall a dream any more than the control participants did. This indicates that the basolateral amygdala is not critical to successful dream recall, although it may be involved in the process.

Unfortunately, this study was not completely able to separate the effects of bilateral basolateral amygdala damage on dreaming from the possible effects of bilateral basolateral amygdala damage on dream recall. For example, it is possible that basolateral amygdala damage leads to a bias in the types of dream experiences that are recalled, or reduces the extent to which dreams are accurately recalled. The latter possibility may be reflected by the finding that UWD patients' dream reports were significantly shorter than the controls' dream

reports (see the discussion of word count results), although it is important to bear in mind that the UWD patients did not appear to struggle especially with dream recall.

Given that any attempt to examine an individual's subjective dream experiences inevitably relies on the individual's recall of the dream, this is not an easy problem to circumvent. However, this problem might be reduced if the dream reports were collected in a sleep laboratory. This possibility is discussed in more depth in the 'Directions for future research' section.

Intensity of Positive and Negative Affect

Given that amygdala damage has repeatedly been linked to the impairment of negative affect (especially fear and anger) in waking life (e.g. Adolphs et al., 1994; LeDoux, 2003), the idea that amygdala damage might lead to impaired fear, anger, and negative affect in dreaming is perhaps the most relevant and defensible hypothesis examined by this study. Indeed, several dream theories have proposed a central role for the amygdala in the generation of negative emotion (and particularly fear) in dreaming (Domhoff, 2001; Hobson et al., 2000; Revonsuo, 2000).

The intensity of negative affect was found to be significantly lower among the UWD patients' dream reports than it was among the control participants' dream reports ($p = .037$), although the effect size was relatively small ($r = -.20$). This result provides the first concrete support for the common hypothesis that amygdala damage should lead to reduced negative affect in dreams.

The intensity of positive affect was found to be higher among the UWD patients' dream reports than it was among the control participants' dream reports. This difference was highly significant ($p = .003$) and the moderate effect size ($r = .32$) was one of the largest effect sizes returned by this study. However, finding significant results of any effect size (and this study was able to uncover a number of significant results) is a substantial discovery if one considers the numerous challenges faced in dream research in general, and in this study in particular.

In terms of previous speculation regarding the likely effects of amygdala damage on dream affect, the central hypothesis suggested by a number of dream theorists, as well as by most previous research, is that amygdala damage could lead to reduced negative affect in dreams (Domhoff, 2001; Hobson et al., 2000; Revonsuo, 2000) and possibly also to reduced affect in general (Wiest and Brainin, 2010). It is therefore quite interesting to find that UWD patients in fact seemed to exhibit increased positive affect. However, this finding is consistent

with research that has suggested that UWD patients might also express predominantly positive emotions in their waking life (Adolphs, Tranel & Damasio, 1998), as well as Domhoff's (2001) prediction that amygdala damage would lead to dreams with a higher proportion of positive to negative emotion than is the norm.

Panksepp's Basic Emotions

The variable of PLAY had a significantly higher mean intensity among the UWD patients' dream reports than it had among the controls' dream reports (p = .046), although the effect size was small (r = .19). There were no instances of RAGE whatsoever among the UWD patients' dream reports, which was significantly different to the controls' dream reports (p = .019). This effect was slightly stronger (r = -.24). These findings echo the significantly higher intensity of positive affect and the significantly lower intensity of negative affect among the UWD patients' dream reports.

The absence of RAGE in the UWD patients' dream reports is in line with a number of studies that have implicated the amygdala in the recognition of stimuli expressing anger (e.g. Scott et al., 1997). However, such studies have focussed almost exclusively on the recognition of anger in external stimuli, and there is little existing evidence linking the amygdala to the internal experience of anger (Damasio et al., 2000; Denson, Pederson, Ronquillo & Nandy, 2009), although Panksepp (2014) does suggest that the structure is involved in the RAGE system.

For each of the remaining basic emotions, with the exception of LUST, which was not observed in any of the dream reports, the mean intensity level was slightly higher for the control participants than it was for the UWD patients, although none of these differences were significant.

The absence of LUST from all the dream reports is interesting, but not entirely surprising when one considers the demographics of the sample. The UWD patients (and consequently the matched controls) live in conservative, religious communities, and would probably feel uncomfortable speaking about subjects that contain erotic content. The participants' Christian beliefs come across very strongly in their dream reports, as many of them interpreted their dreams as being messages from God, Jesus or deceased relatives.

It is also interesting, considering the large body of research linking the amygdala to various types of fear processing (see the 'Amygdala's Waking Function' section), that there was no significant difference between the two groups in terms of their level of FEAR. Qualitatively, it appears that though there were initially similar levels of threatening

situations and appropriate FEAR responses among the two groups' dream reports; the threatening situation was more frequently resolved in the UWD patients' dream reports than it was in the control dream reports. This is, again, consistent with the finding that the UWD patients' dream reports were more positive over-all.

Wish Fulfilment

The UWD patients' dream reports had a significantly higher mean wish fulfilment score than the control participants' dream reports. This effect was highly significant (p = .009) and moderately strong (r = .26). This result is once again in keeping with the pattern of UWD patients' dream reports being generally more positive than the controls' dream reports.

From a qualitative standpoint, the wish fulfilling nature of the UWD patients' dream reports was also very clearly observable. A number of their dream reports were short, simple, very clearly wish-fulfilling dreams of a type not observed among the control groups' dream reports. Indeed, the decision to investigate wish fulfilment was made chiefly on the basis of this qualitative observation that the UWD patients' dream reports seemed to frequently consist of simple wish fulfilment dreams of the type conceptualised by Freud (1900/1954). For example, one typical dream report from an UWD patient ran as follows: "I dreamt that my unemployed husband got work, and I became very happy that he found work. The work was close to our home here in Kleinzee, and the work that he did was at the plant". Or, another report: "I dreamt that I was sitting under a tree and when I looked up there was fruit hanging in the tree. Big pears and apples and one specific fruit that I wanted to pick was so beautifully ripe. Then I picked it. That fruit that I picked made me feel very happy". Finally, a third example: "I dreamt that my [disabled] daughter was walking. I often dream that she's walking. God shows me exactly how my child walk".

Not all of the UWD patients' dream reports were so entirely wish fulfilling; however, as mentioned above, and evident in the dream report example provided in the 'Nightmares' section below, many of their dream reports that did contain negative or threatening aspects also contained some element of resolution or wish fulfilment. The 0-3 scale used to assess the extent to which each dream constituted the fulfilment of a wish (see APPENDIX C) was also sensitive to picking up wish-fulfilling elements in these not-entirely wish fulfilling dreams. These elements would therefore also have contributed to the overall higher mean wish fulfilment score observed among the UWD patients.

Nightmares

This study's results clearly indicate that it is possible for patients with bilateral basolateral amygdala lesions to experience nightmares; however, it seems that these nightmares are rare. Six of the UWD patients were asked if they understood what a nightmare was and whether they had ever had one. Although all six reported that they understood the concept of a nightmare, three of them (50%) said that they had never experienced a nightmare before. Of the sixteen controls who were asked the same questions, fourteen understood the concept of a nightmare and only two of the fourteen (14%) said that they had never experienced a nightmare before. Unfortunately, these numbers are not large enough to accurately detect whether or not the UWD patients were statistically more likely to never have had a nightmare than the control participants were, though it does seem as though this might be the case.

What is clear is that the UWD patients' dream reports were significantly less likely to be nightmares than the control participants' dream reports were. Specifically, the controls' dream reports had a 3.5 times greater chance of being classified as nightmares than the patients' dream reports. Furthermore, when none of the participants' were specifically asked to recall a nightmare, the controls' dream reports had a 6.6 times greater chance of being classified as nightmares than the patients' dream reports. This finding is consistent with research linking the over activation of the limbic system in patients with post-traumatic stress disorder (PTSD) to the elevated prevalence and severity of nightmares experienced by such patients (Levin et al., 2010). Various dream theorists have also speculated that the amygdala is involved in the generation of nightmares, and particularly in the experience of fear in nightmares (Domhoff, 2001; Levin & Nielsen, 2007; Revonsuo, 2000).

It is therefore interesting that, although UWD patients did have significantly fewer nightmares, there appear to be comparative levels of FEAR intensity between the UWD patients' dream reports and the control participants' reports. This fits with the qualitative observation that, although there can be negative and scary aspects to the UWD patients' dreams, these negative aspects might not affect the UWD patients as severely as they affect the control participants, and these scary or negative aspects are more often resolved. For example, one of the patients dreamt that she was lost in a big city among crowds of people, feeling stressed and a bit frightened – until her brother came up to her and told her she had taken a wrong turn, and showed her which way to go. This left her feeling happy and excited.

Bizarreness

The overall proportion of bizarre dream elements relative to non-bizarre dream elements was similar across the two experimental groups (10.9% of all the elements identified in the UWD patients' dream reports were coded as being bizarre, as were 11.5% of the elements identified in the controls' dream reports). The measure used, namely Revonsuo and Salmivalli's (1995) method for content analysis of bizarre elements in dreams, categorised bizarre dream elements into three major types. For two of the three major bizarreness types ('vague' and 'discontinuous') the prevalence was virtually identical across the two groups. The only difference was in the third type ('incongruous), with 3.9% of the elements in the UWD patients' dream reports were coded as incongruous and 5.9% of the elements in the controls' dream reports being coded as incongruous. 'Vague' elements were dream elements that were indeterminate, unknown, or obscure in a manner that would not occur in waking life. 'Discontinuous' elements were dream elements that suddenly appeared, disappeared, or transformed. And 'incongruous' elements were dream elements that would have been out of place or impossible in waking life. See APPENDIX C for an exact explanation of the coding of bizarre elements.

The 'incongruous' category can be further divided into three subtypes, namely; 'distorted' elements (dream elements of which some feature or characteristic had been distorted, e.g., a person in your dream is much smaller than they are in reality); 'exotic' elements (dream elements which the dreamer is highly unlikely to encounter in reality, but which are in principle possible, e.g., you have lunch with the Pope); and 'impossible' elements (dream elements which are impossible in reality, e.g., your dead cat comes back to life). The prevalence of exotic elements was identical among the UWD patients' and the control participants' dream reports. The prevalence of distorted elements was also similar across the two groups, with 2.1% of the UWD patients' dream elements and 2.8% of the control participants' being coded as distorted. The only substantial difference was between the prevalence of impossible elements in the two groups' dream reports. Here, 5.9% of the dream elements in the control participants' dream reports, but only 0.9% of the dream elements in the UWD patients' reports, were coded as being impossible. Furthermore, the adjusted standardised residual of 1.9 approached the significance threshold of 1.96, indicating that the number of impossible elements in the UWD patients' dream reports was very nearly significantly fewer than would be expected, based on chance.

However, the overall chi-square statistic remained non-significant. This finding is not surprising considering that these 'impossible' elements made up just one minor subtype of

Revonsuo and Salmivalli's (1995) content analysis scheme. The fact that this scheme analysed so many other types of bizarreness may have clouded the results somewhat. For example, the prevalence of 'vague' elements might be a reflection of poor dream memory or poor articulation, and not necessarily a reflection of actual dream bizarreness. The UWD patients do have difficulties speaking, and many of their dream reports were rather unclear. It also remains possible that the bilateral basolateral amygdala damage could impact the UWD patients' dream memory to some extent (see above). Furthermore, many of the control participants and the UWD patients were not well educated, and this is likely to have affected their vocabulary and possibly their ability to articulate their dream narratives. The prevalence of 'discontinuous' dream elements may also, to some extent, have been due to unclear narration of the dream stories.

Colace (2010, p. 110) argues that the dream literature has consistently suggested that there are two major qualities at the root of bizarreness in dreams, namely; "(a) impossibility, and (b) improbability and/or oddness compared to common daily experiences". Both of these qualities would fall under what Revonsuou and Salmivalli (1995) termed 'incongruous' dream elements. It is possible that there might have been a difference between the levels of bizarreness in the UWD patients' and the control participants' dream reports if a scale had been used that focussed only on these types of bizarreness.

For example, Colace, Violani and Solano (1993) developed a scale that attempted to formalise Freud's classification of dream bizarreness. This scale classifies dreams as being either: (i) sensible, plausible and without strange elements; (ii) sensible and consistent within itself, but strange compared to everyday life; or (iii) senseless, inconsistent and bizarre. Perhaps, if this (or a similar) scale were to have been applied, it might emerge that, relative to the controls' dream reports, fewer of the UWD patients dream reports would have fallen into Colace et al.'s (1993) third category.

Word Count and Narrative Item Count

The control participants' dream reports had a significantly higher word count and narrative item count than the UWD patients' dream reports. Both of these measures returned impressive, moderately strong effect sizes. The word count result was particularly noteworthy (r = -.34, and r = -.39 when the specifically requested 'nightmares' - which tended to be shorter than the other dream reports - were removed). This suggests that bilateral basolateral amygdala damage leads to dreams that are not only significantly shorter than normal, but also significantly less complex narratively. The UWD patients' dream reports contained less

meaningful chunks of information and less detail, leading to simple dream narratives. These results are in line with De Gennaro et al.'s (2011) finding that increased diffusivity of the left amygdala was associated with shorter dream reports.

However, it is difficult to determine whether the lower word and narrative item count are entirely reflective of a quality intrinsic to the UWD patients' dreams, or whether these low counts might also be influenced by possible impaired memory, or a reluctance to speak due to their vocal difficulties. In an attempt to address this question, the word and narrative item counts of a sample of happy memories were analysed.

The mean word and narrative item count of the happy memories were both lower for the UWD patients than for the control participants. However, this difference was non-significant for both the word count and the narrative item count. This finding suggests that the UWD patients' shorter and simpler dream reports are not due to a general unwillingness to speak or to impaired memory. It would therefore seem that bilateral basolateral amygdala damage does in fact have a specific impact on the length and narrative complexity of dream reports, as opposed to merely reducing the length of reports in general. Although it could be that the UWD patients suffer from memory problems that are specific to their dream recall (and not to the recall of other types of narratives), this seems unlikely – especially considering that they did not show any especial difficulty in initiating and maintaining dream recall (see above). It therefore seems reasonable to assume that the patients' actual dreams were in fact shorter and simpler than the control participants' dreams.

However, due to the small number of happy memories that were analysed, and the extent to which *p*-values are influenced by sample size (Field, 2009), these non-significant *p*-values should be interpreted with great caution. The moderately strong effect sizes suggest that these tests might well have returned significant results if more happy memories had been collected. Furthermore, the word and narrative item counts for the happy memories had inter-rater reliability scores below the desired level of .8. Although the levels of inter-rater reliability were still reasonable, this also impacts on the confidence with which these findings can be interpreted. This reduced level of inter-rater reliability is possibly due to the fact that these measures were conducted sometime after the raters first established and practiced this particular coding method.

Of course, even if the UWD patients' happy memories are shorter and simpler than the norm, this does not necessarily mean that the shorter dream reports are only due to a reluctance to speak and not also to any intrinsic quality of the patients' dreams. Further investigation is necessary in order to confidently determine whether bilateral basolateral

amygdala damage does in fact lead to a decrease in the length and narrative complexity of UWD patients' actual dreams.

Threat

The results pertaining to threat in the participants' dreams once again supported the idea that the negativity in UWD patients' dream reports tends to resolve itself. Although the patients' dream reports actually contained a slightly higher incidence of significant physical threat than the control participants' dream reports did, the UWD patients were able to successfully escape a higher percentage of threats in their dreams than the control participants were.

It is also interesting to note that, although the UWD patients experienced slightly more threats than the control participants, a significantly greater proportion of the threats experienced by the controls were life-threatening than those experienced by the UWD patients. Indeed, the odds of a threat in a control participant's dream report being life-threatening were 10.5 times higher than the odds in an UWD patient's dream report. These results should be interpreted with some caution due to the relatively small sample size (the UWD patients only experienced a total of nine threats in their dream reports and the controls had a total of twelve threats). However, the discovery of a significant p value ($p = .016$) despite this small sample, taken together with the strong effect size ($\phi_{Cramer} = .51$) and the high odds ratio, do suggest that there is a real robust effect at work here. The larger amount of life-threatening instances among the control participants' threats seems to echo the idea that negative events in the control participants' dream reports tend to be more intense than the negative events in the UWD patients' dream reports.

For both the UWD patients and the controls, the vast majority of the threats they experienced in their dream reports were what Revonsuo (2000) termed 'ancestral' as opposed to 'modern'. Given that all of the threats involving direct physical aggression from another person or animal were coded as ancestral, it is not surprising that these threats made up the greatest proportion of the threats.

According to the odds ratio, the UWD patients were 2.57 times more likely than the controls to escape the threat in their dreams, although fewer of the UWD patients' escapes were realistic. However, neither of these differences was significant.

In total, 6.9% of the control participants' dream reports, and 7.7% of the UWD patients' dream reports, contained both a significant physical threat to the dreamer and a subsequent realistic escape. These percentages, while small, are slightly higher than results

returned by previous studies, which tend to show that less than 5% of normal dream reports contain realistic physical threats and subsequent realistic escapes (Malcolm-Smith & Solms, 2004; Malcolm-Smith et al., 2008; Zadra et al., 2006).

Approach versus Avoidance Behaviour

Although the UWD patients' dream reports showed a slightly greater incidence of approach behaviour than the control participants' dream reports, this difference was not significant. In total, 76.9% of the UWD patients' dream reports were coded as incidences of 'approach', as were 74.1% of the control participants' dream reports. These figures are both very similar to Malcolm-Smith et al.'s (2012) finding that 74.3% of a South African sample's dream reports were incidences of approach behaviour. This result therefore reinforces the idea that dreams generally tend to show more approach behaviour than avoidance behaviour, and it seems that bilateral basolateral amygdala damage has little impact on this tendency.

Factor Analysis

A principal components analysis strongly suggested that there are three major factors that underlie the various results, namely: an 'unpleasantness' component, a 'length' component', and a 'danger' component. The fact that the different variables grouped together so convincingly onto these three components is indicative of the validity of the various measures that were used to assess the dream reports. For example, positive affect scores were positively correlated with PLAY and wish fulfilment scores, and negatively correlated with negative affect, nightmare, and FEAR scores. As a result, positive affect, PLAY, and wish fulfilment all had very strong negative loadings on one component (the 'unpleasantness component'), and negative affect, nightmares, and FEAR all loaded positively on this same component. This suggests that these variables were all tapping into the same underlying real-world characteristic of the dream reports.

Comparing the UWD patients' and the control participants' scores for these three components reinforces three ideas that have become apparent over the course of this study. Firstly, it is clear that the dream reports of UWD patients are significantly more pleasant, and less unpleasant than the dream reports of control participants, as the UWD patients scored significantly lower than the control participants on the 'unpleasantness' component. This difference was highly significant (p = .004) and the effect was moderately strong (r = -.29). Secondly, it is clear that the dream reports of the UWD patients are significantly shorter than those of controls, as the UWD patients also scored significantly lower than the control

participants on the ‘length’ component (p = .027). This effect was also moderately strong (r = -.21). Thirdly, it is clear that the dream reports of UWD patients show similar levels of threat and FEAR to the dream reports of the control participants, as the two groups showed no significant difference in score on the ‘danger’ component.

In summary, there is strong converging evidence to suggest that bilateral basolateral amygdala damage leads to dreams that are shorter, simpler, more pleasant, less unpleasant, more wish fulfilling, and less likely to be nightmares than is the norm. It seems that although bad things can, and do, happen in the dreams of patients with bilateral basolateral amygdala lesions, these patients’ negative emotional experiences tend to be less intense than those of control participants, and the bad things tend to be resolved more frequently than is the norm.

Implications for the Dopaminergic SEEKING Model of Dreaming

Although this model does not specify a clear role for the basolateral amygdala, some of this study’s results do provide support for this model. For example, preserved dreaming in UWD patients is in line with Solms’s (2000) argument that the dopaminergic SEEKING system (as opposed to a system centring on the amygdala) is the critical system in dream production. In addition, the high levels of approach behaviour in both the UWD patients’ and the control participants’ dream reports (which are in line with findings by Malcolm-Smith et al., 2012), also support the hypothesis that dreams are driven by SEEKING behaviour.

In light of the evidence provided by the current study, Solms’s (2000) model should perhaps now include a role for the basolateral amygdala in certain aspects of dream production.

Implications for the AIM Model

The significantly lower mean intensity of negative emotion in the UWD patients’ dream reports supports Hobson et al.’s (2000) idea that the amygdala is involved in the intensity of negative emotions in dreams. The fact that the UWD patients’ dream reports showed lower intensity levels for each basic emotion (except PLAY) also lends some support to the idea that the amygdala could be involved more generally in the production of emotion in dreams. However, this idea is contradicted by the significantly higher mean intensity of positive emotion in the UWD patients’ dream reports.

Given that the UWD patients had damage confined to the basolateral nuclei of the amygdala bilaterally, this discussion cannot comment on the possible involvement of the central nuclei of the amygdala in dreaming processes. However, theories that place huge

weight on the importance of the amygdala in dreaming are called into question. Although the lower word and narrative item counts observed in the UWD patients' dream reports are in line with Hobson's (2004) idea that the amygdala is involved in the development of dream plots, the structure is clearly not critical to the generation of dream plots.

Implications for the AMPHAC model

Levin et al.'s (2010) AMPHAC model also places significant emphasis on the amygdala's role in dreaming (the first A in AMPHAC stands for amygdala). On the basis of their theories, and those of Hobson et al. (2000), but apparently without the support of any empirical evidence, Levin et al. (2010, p. 235) make the rather bold statement that "the hippocampus and amygdala are now considered to be integral in basic dream production". However, the present study proves quite clearly that patients without functioning basolateral amygdalae are still able to produce dreams that are in many ways comparable to those of healthy individuals. It therefore seems that the AMPHAC model (along with the AIM model) may place too strong an emphasis on the role of the amygdala in the generation of dream plots. The results of the present study do, however, provide some support for the idea that the amygdala is involved in the generation of dream plots, as well as for Levin et al.'s (2010) idea that the amygdala is involved in the generation of nightmares.

Implications for TST

Two dream report analyses (namely, the analysis of threat and escape; and the analysis of approach versus avoidance behaviour) were included specifically to test three hypotheses which were generated based on Revonsuo's (2000) TST. However, none of these hypotheses were supported by this study. Threat simulation theory argues that dreaming constitutes an evolutionary adaptive means for the human mind to practice responding to threatening situations in safety. Within TST, the amygdala is believed to be crucial to both recalling the negatively charged emotional memories on which threatening dreams are supposedly based, and also to the subsequent response to the threatening situation in the dream (see the 'Dream Theories and the Amygdala' section for more detail).

The analyses of threat in the dream reports revealed no significant difference between the prevalence of threat in the UWD patients' and control participants' dream reports. In fact, the odds of an UWD patients' dream report containing a significant physical threat to the dreamer were slightly higher than the odds of a control participants' dream report containing

such a threat. This finding strongly contradicts the idea that the basolateral amygdala is necessary for the initiation of threatening dreams.

Furthermore, if dreaming constitutes the priming of a fear-conditioning network that centres on the amygdala, then this conditioning network should be impaired in patients with basolateral amygdala damage. This would then result in an inability to form conditioned fear responses and consequently less successful avoidance of dream threats. However, there was no significant difference between the UWD patients' and the control participants' ability to escape the threats in their dream reports, either realistically or unrealistically. The UWD patients were in fact more likely to escape the threat in their dreams, though their escapes were less likely to be realistic. This finding contradicts TST's claim that the amygdala is responsible for responding to threat in dreams.

Revonsuo's theory argues that the amygdala is central to threat-avoidance behaviour in dreams, and therefore predicts that threat-avoidance behaviour would be significantly less prevalent in the dreams of patients with basolateral amygdala damage. However, the two groups did not differ in the prevalence of avoidance behaviour in their dream reports.

This theory also predicts that threat and escape should form a common theme in dreams, yet only a small percentage of the dream reports in this study included a significant threat and a subsequent realistic escape. In addition, the vast majority of both the UWD patients' and the control participants' dream reports were predominantly incidences of approach behaviour, as opposed to avoidance behaviour. These findings are in line with those of Malcolm-Smith and Solms (2004), Malcolm-Smith et al. (2008), Malcolm-Smith et al. (2012), and Zadra et al. (2006).

The present findings stand in contradiction to those of Valli. Strandholm, Sillanmäki, and Revonsuo (2008), who report that threat is over-represented in dreams. Valli et al. (2008) reach this conclusion by comparing the incidence of threat in dreams to the incidence of threat in waking life. Due to a lack of information regarding threat in the waking life of the participants, it was not possible to make a similar comparison in the present study. However, the difficult living conditions faced by the participants would predict a high level of threat in their daily lives. In summary, these results contribute substantially to a growing body of evidence challenging a number of TST's central assumptions.

Similarities between UWD patients' and Young Children's Dreams

Perhaps the most interesting result of the present study is the unexpected, but very striking similarity between the characteristics of the UWD patients' dreams, and the characteristics of

children's dreams, as described by Freud. Freud (1900/1954) held that the dreams of children were perfect demonstrations of his belief that all dreams are essentially wish fulfilling. He argued that it was only between five and eight years of age that children begin to develop superego functions, which cause them to repress and distort the desires expressed in their dreams. In his review of the literature, as well as his own studies, Colace (2010) demonstrated that young children's dreams are generally pleasant, simple, non-bizarre and wish-fulfilling.

A majority of the UWD patients' dreams fit this picture (see the examples in the 'Wish Fulfilment' discussion). Although these are quite ideal examples, the statistical results reveal that this is true of the general picture; it was shown that the UWD patients' dream reports were significantly shorter, simpler, more positive, less negative, and more wish fulfilling than the controls' dream reports. The only exception to this is that the UWD patients' dream reports were not found to be less bizarre than the controls' reports, but this might have been due to our bizarreness measure not accurately assessing the types of distortions that are relevant to Freudian dream theory.

Freud attributed the simple wish-fulfilling nature of children's' dreams (or in other words, the lack of distortion in children's dreams) to the lack of a developed superego. In order to explain the relationship between the superego and dream distortion, Freud drew analogy between dream production and an entrepreneur and a capitalist. The entrepreneur has the idea for a business, which Freud likened to the day residue in the conscious mind providing the impulse, or the idea, to start a dream. This function is supposedly preserved in children. The capital, which fuels and intensifies this dream, supposedly comes from unconscious, uncomfortable, infantile wishes which have been suppressed by the superego. Children do not yet possess such capital, and therefore their dreams remain simple wish fulfilments.

Therefore, if the dreams of UWD patients are similar to those of young children, then this raises the interesting idea that the basolateral amygdala could play a role in the circuits that underlie superego functions in the human brain. This idea is not entirely dissimilar to the common idea that the basolateral amygdala is involved in fear-conditioning (Adolphs, 2010; Killcross et al., 1997; Sierra-Mercado et al., 2010).

The Current Findings in Relation to Recent Research on the Waking Amygdala

The preserved ability to generate emotions in dreams despite bilateral basolateral amygdala damage would be in line with the recent research that suggests that the amygdala is involved

in *modulating* reactions to external affective stimuli, and is not a centre for the internal *generation* of emotion (Adolphs, 2010; Sander et al., 2003). However, bilateral basolateral amygdala damage was associated with a decrease in certain emotions (namely negative affect and RAGE), and an increase in certain other emotions (namely positive affect and PLAY). These findings suggest that the structure does play a role in the internal emotional experiences of dreams.

Nevertheless, the results do still provide some evidence for the idea that the basolateral amygdala's role is chiefly to do with analysing the valence of emotionally charged stimuli (Pessoa & Adolphs, 2010; Pessoa, 2010; Sander et al., 2003). Such a hypothesis would be in line with findings that suggest that, despite normal levels of threat in the dream reports, the emotional reactions of UWD patients to these threats are limited (as demonstrated by the reduced negative affect and incidence of nightmares in their dream reports).

Limitations and Directions for Future Research

The dream reports in this study were collected using the *Most Recent Dream (MRD)* method. In short, the MRD method asks participants to recall, in as much detail as possible, the most recent dream they can remember having (Avila-White et al., 1999). The MRD method has been shown, across cultures and socio-economic groups, to be at least as effective and reliable as any other method of dream collection, including dream reports that are collected in the laboratory (Domhoff, 2000). However, the amygdala has been repeatedly implicated in emotional memory processes (Adolphs, Tranel & Buchanan, 2005; Adolphs, 2010). Therefore, it is possible that relying on patients with calcified basolateral amygdalae to accurately recall their dreams some days after they have actually dreamt them may lead to inaccurate data.

Perhaps collecting the dream reports in a sleep laboratory setting, where participants can be woken from REM and asked to recall their dreams immediately, and/or asked to recall their dreams first thing on waking, will result in more veridical reports. This may also give participants less time to edit, interpret and/or censor their dreams. During the analysis of the dream reports it was at times difficult to separate the participants' actual dreams from their religious (Christian) interpretation of their dreams. Nevertheless, every effort was made to present the dream reports to the raters in such a manner as to clarify, to as great an extent as possible, what was and was not part of the actual dream.

As explained under the in the discussion of the bizarreness results, the bizarreness measure that was utilised may have been inappropriate for the needs of this study. Future research should examine bizarreness in UWD patients' dream reports using a more appropriate measure, such as the one developed by Colace et al. (1993).

Throughout this study, the differences between the UWD patients' dream reports and the controls' dream reports have been attributed to the UWD patients' bilateral basolateral amygdala lesions. It is however possible that certain other differences between the UWD patients and the control group may also have played a role in the differences observed in their dream reports. In an effort to mitigate this, the groups were rigorously matched on all demographic conditions in order to attempt to ensure that the only difference between the two groups was that the one group had UWD and the other did not. The only other factors, apart from bilateral basolateral amygdala damage, that could realistically be considered to separate the two groups are other symptoms and consequences of UWD. Additional neurological or psychological diagnoses were ruled out among this sample of UWD patients. However, it was not possible to control for the possible effects of a lifelong history of living with the vocal and dermatological effects of UWD (and the possible stigma attached to this), as well as living with the knowledge that they are not only personally living with an incurable genetic condition, but also that this condition runs in their families. All of these factors could reasonably be supposed to impact on the patients' psyches, in various ways that may subsequently have some effect on their dreams or on their reporting of their dreams.

However, without wanting to minimise the possible consequences of living with UWD, these are by no means necessarily the most difficult issues with which these particular people are confronted. The patients and the controls in this study live in communities where poverty and unemployment levels are high, and various other social issues, such as alcohol and drug abuse, poor education and HIV/AIDS, are very prevalent. In addition, due to the relative prevalence of UWD disease among the families in these small rural communities, the stigma attached to the condition is commensurately reduced.

Furthermore, if symptoms of UWD other than bilateral basolateral amygdala damage were affecting the patients' dreams and causing their dream reports to differ from those of the controls, then one might reasonably assume that they would cause the patients' dream reports to be more negative than those of the controls. It would be premature to claim to understand exactly what effect these skin and voice problems (and other possible consequences of UWD) may have on the psychological wellbeing of the patients; however, from interactions with these patients it is clear that the condition is distressing to them. Seeing that this study in fact

suggests that the dreams of UWD patients with bilateral basolateral amygdala lesions tend to be more positive than those of individuals without UWD, it seems reasonable to suppose that this difference is caused chiefly by the patients' basolateral amygdala damage and not by any other aspect of the disease.

This study introduced the interesting idea that bilateral basolateral amygdala damage is associated with simple wish fulfilment dreams of the type typically experienced by young children. This led to the hypothesis that the basolateral amygdala may be involved in the superego circuits that govern the pervasive unpleasant distortions and complications found in the dreams of normal adults. This is (to the best of my knowledge) an entirely new idea, and there is a distinct lack of existing investigation into the neural correlates of superego functions. It is possible to speculate that a pathway between the basolateral amygdala and the orbito-frontal cortex (in which the orbito-frontal cortex has an inhibitory function on amygdala activity) might be involved in superego functions. However, this hypothesis is made without a basis in empirical evidence. Future research should therefore aim to explore the neural basis of superego functions, and particularly the possible role of the basolateral amygdala in such functions.

Conclusion

The evidence provided by this study should prove useful to all dream theorists who have speculated on the role of the amygdala in dreaming. Although the results provide support for the common idea that the amygdala is involved in the generation of negative dream affect, certain theories may also need to be moderated given that the basolateral amygdala is clearly not *essential* to the formation of dreams. In particular, this study provides strong evidence against some of the claims of Revonsuo's (2000) TST of dreaming.

This study found that the dream reports of patients with bilateral basolateral amygdala damage were significantly shorter, simpler, more positive, less negative, more wish fulfilling, and less likely to be nightmares than the dream reports of control participants. Consequently, the dream reports of these patients are strikingly similar to the dream reports of young children.

Contrary to many theoretical predictions, levels of threat and FEAR were not reduced in the UWD patients' dream reports. A possible interpretation of the results is that, although dangerous situations do occur in the dreams of patients with bilateral basolateral amygdala lesions, the patients' emotional reaction to these situations tend to be less intense than that of

controls, and these situations are more frequently resolved in the patients' dream reports than they are in control dream reports.

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APPENDIX A

MRI Scans Showing Basolateral Amygdala Damage in UWD Patients

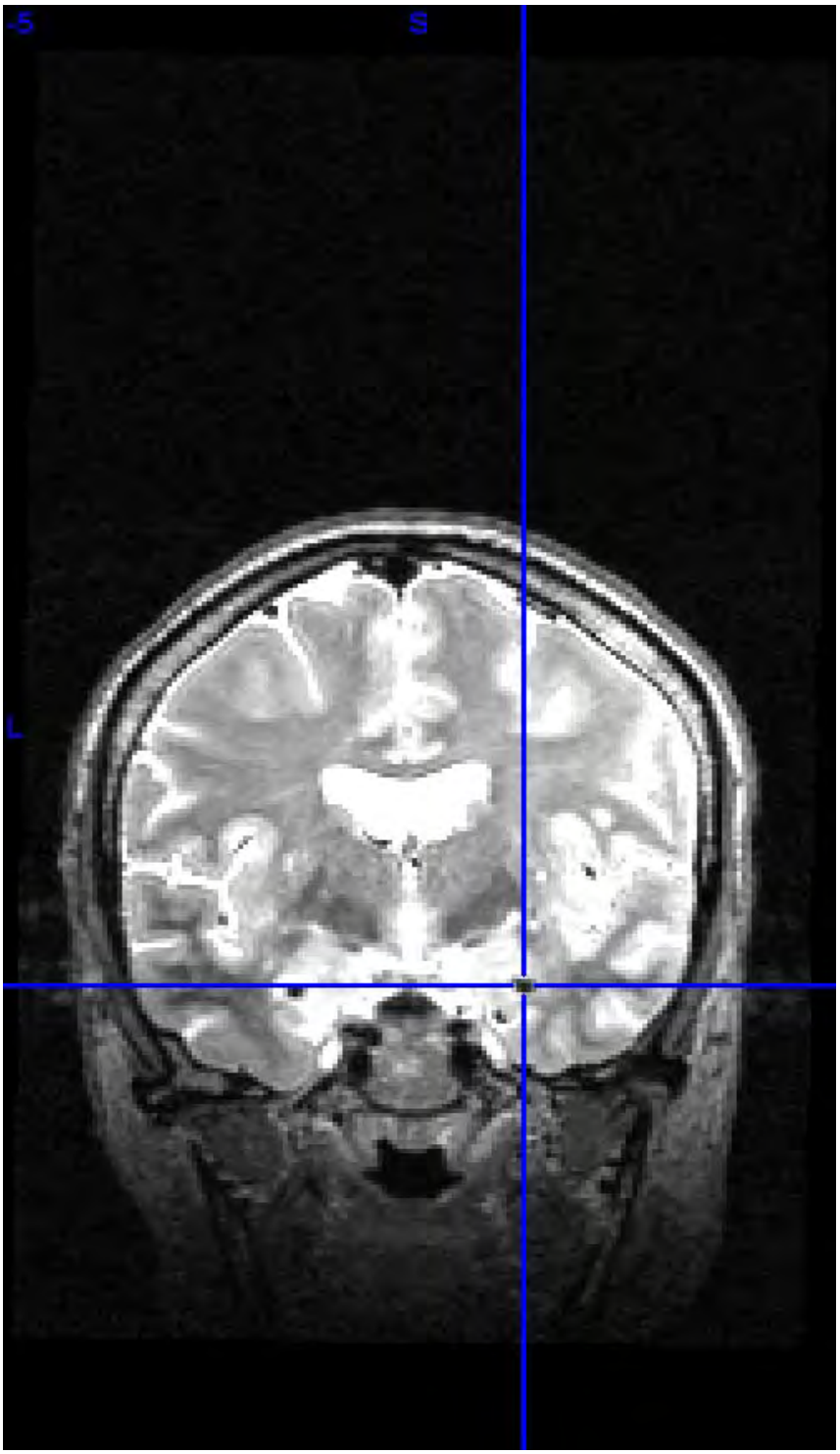

Figure 4. MRI scan for UWD patient no. 1.

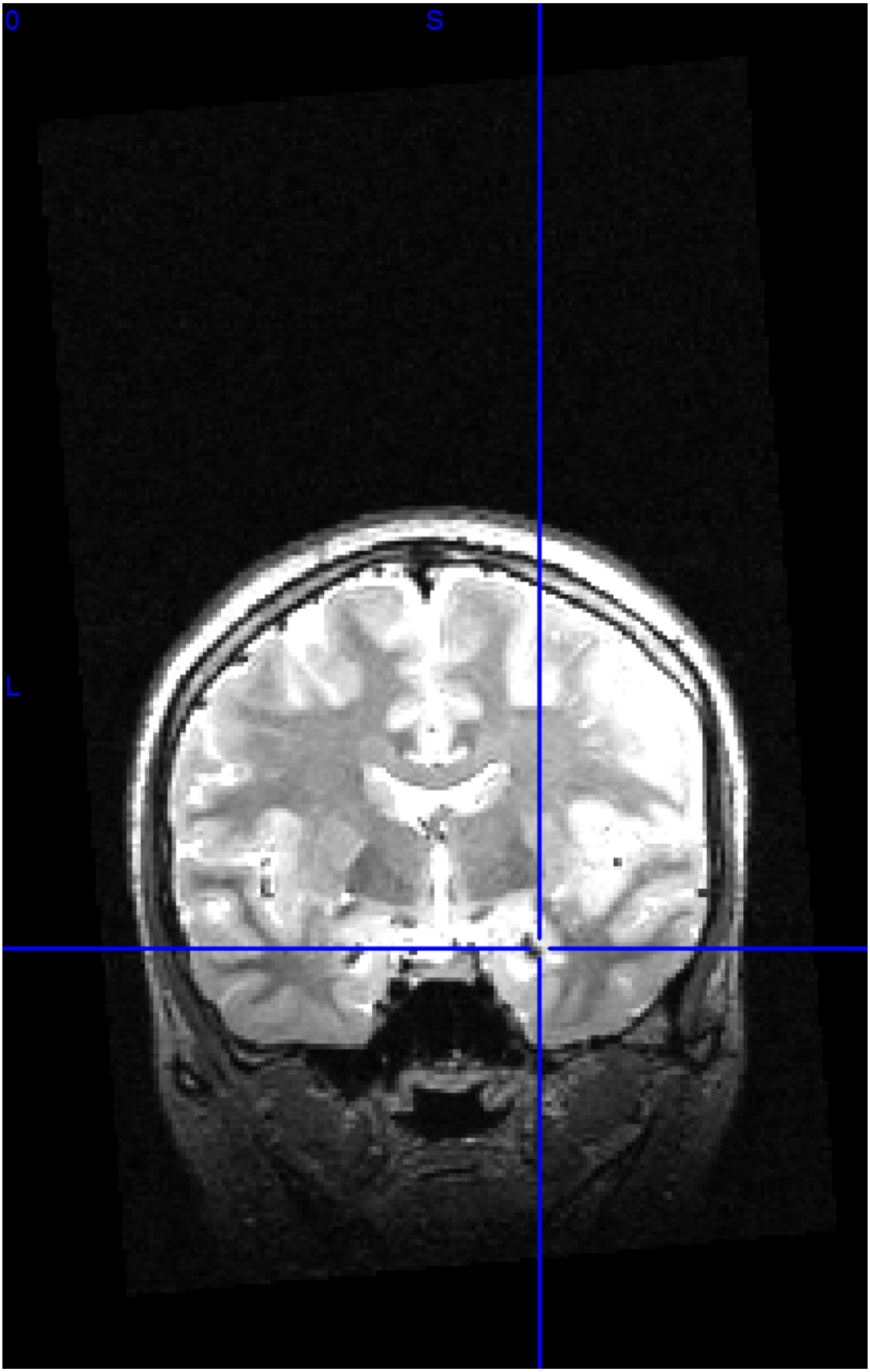

Figure 5. MRI scan for UWD patient no. 2.

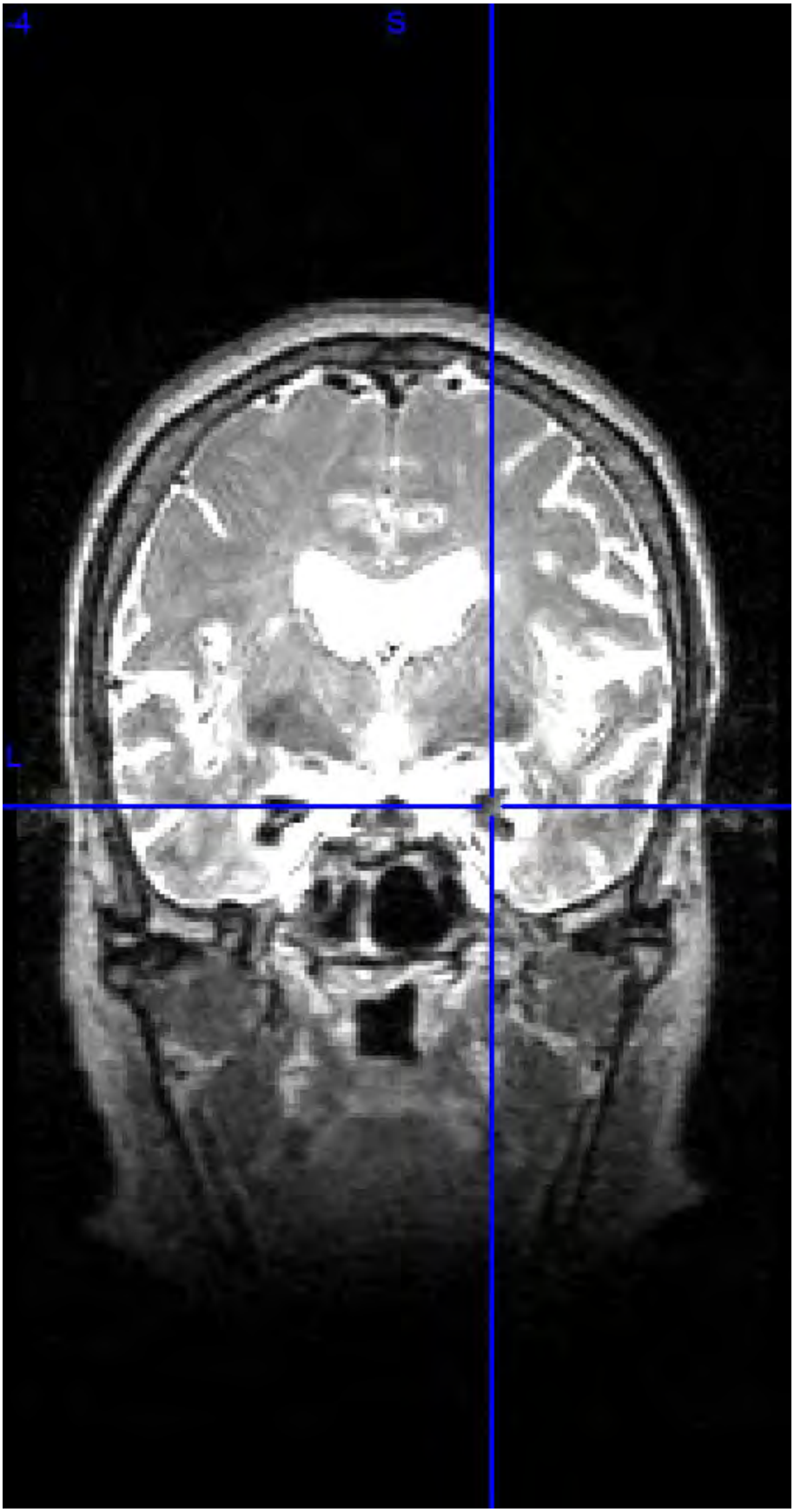

Figure 6. MRI scan for UWD patient no. 3.

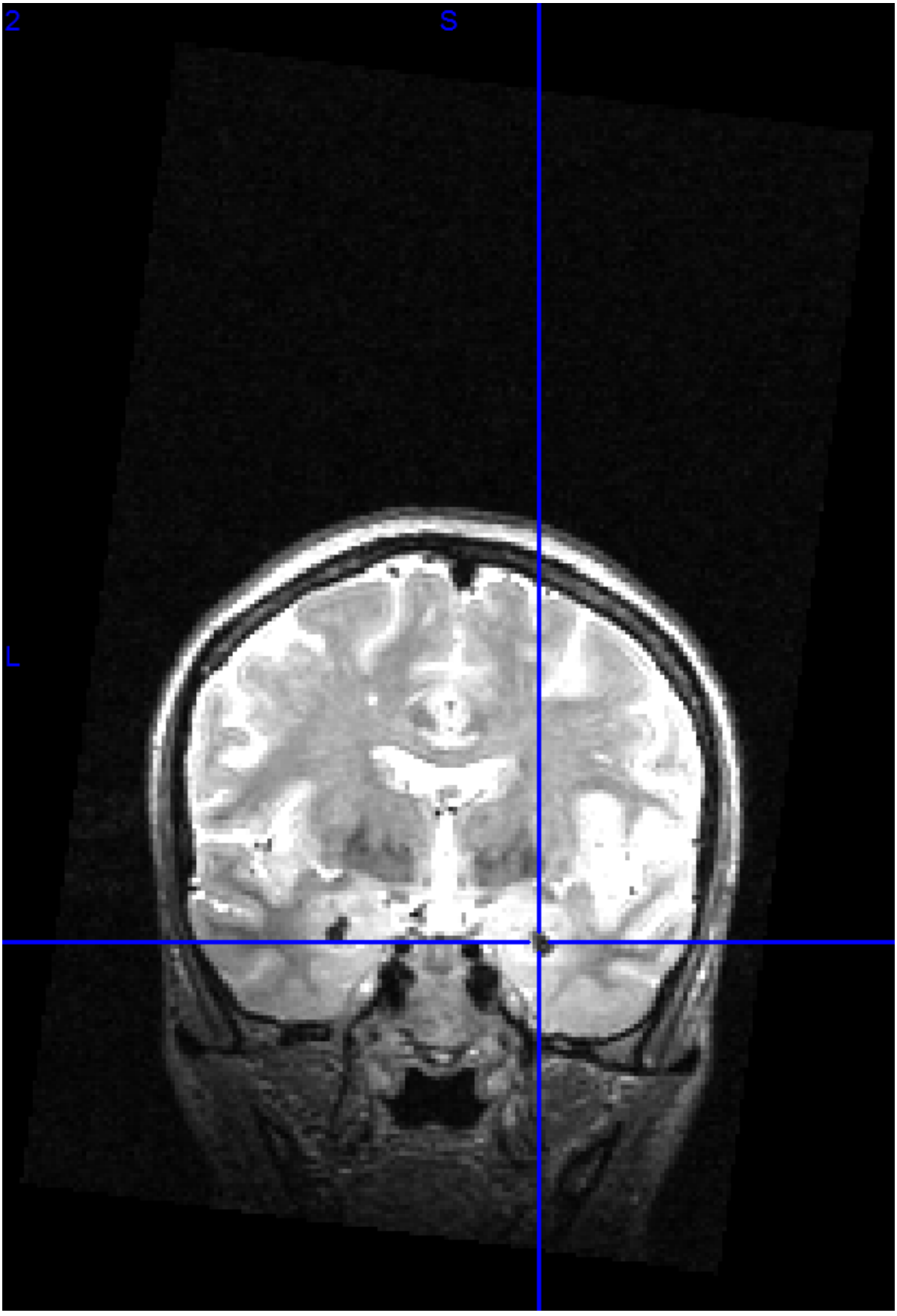

Figure 7. MRI scan for UWD patient no. 4.

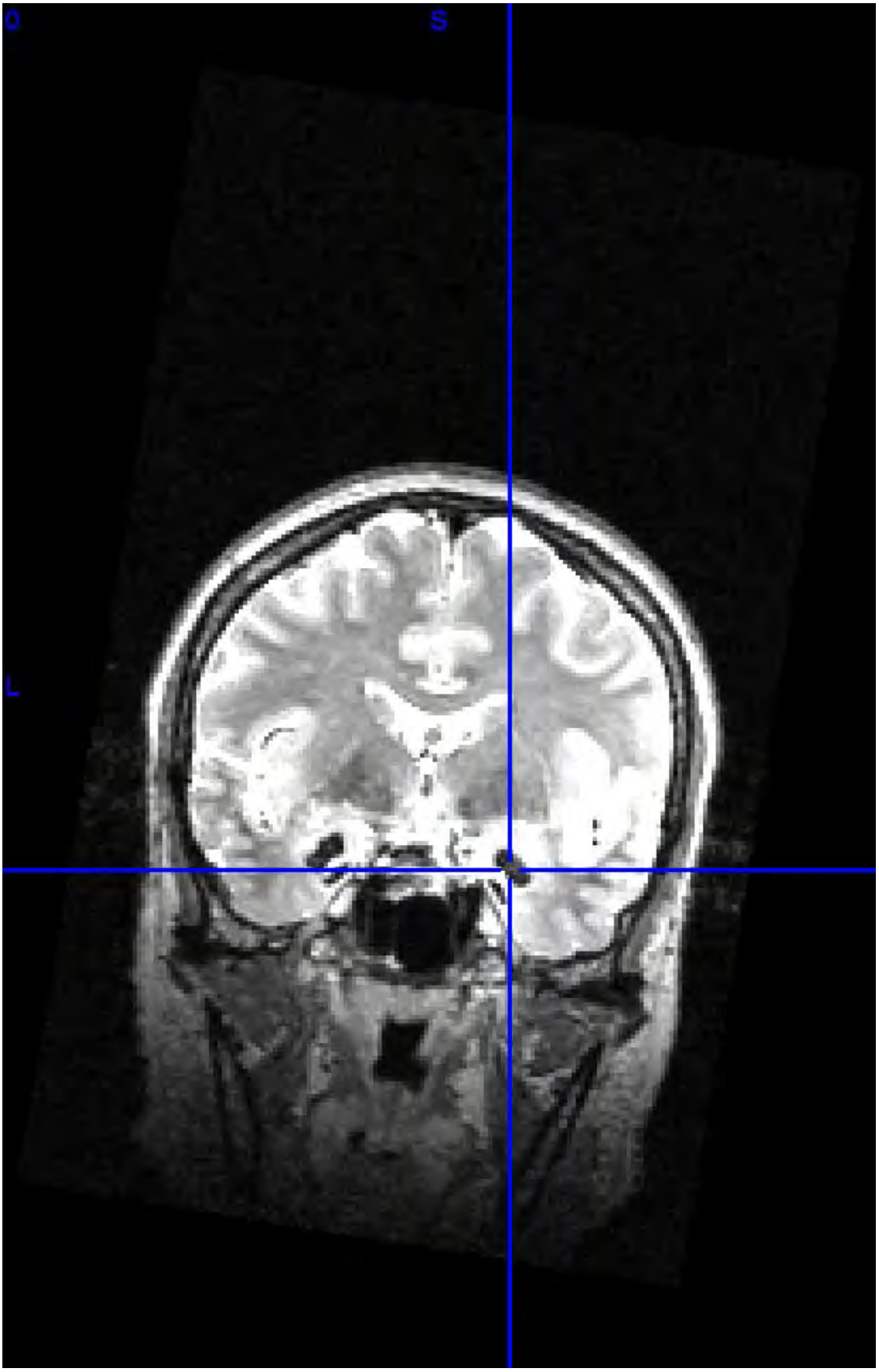

Figure 8. MRI scan for UWD patient no. 5.

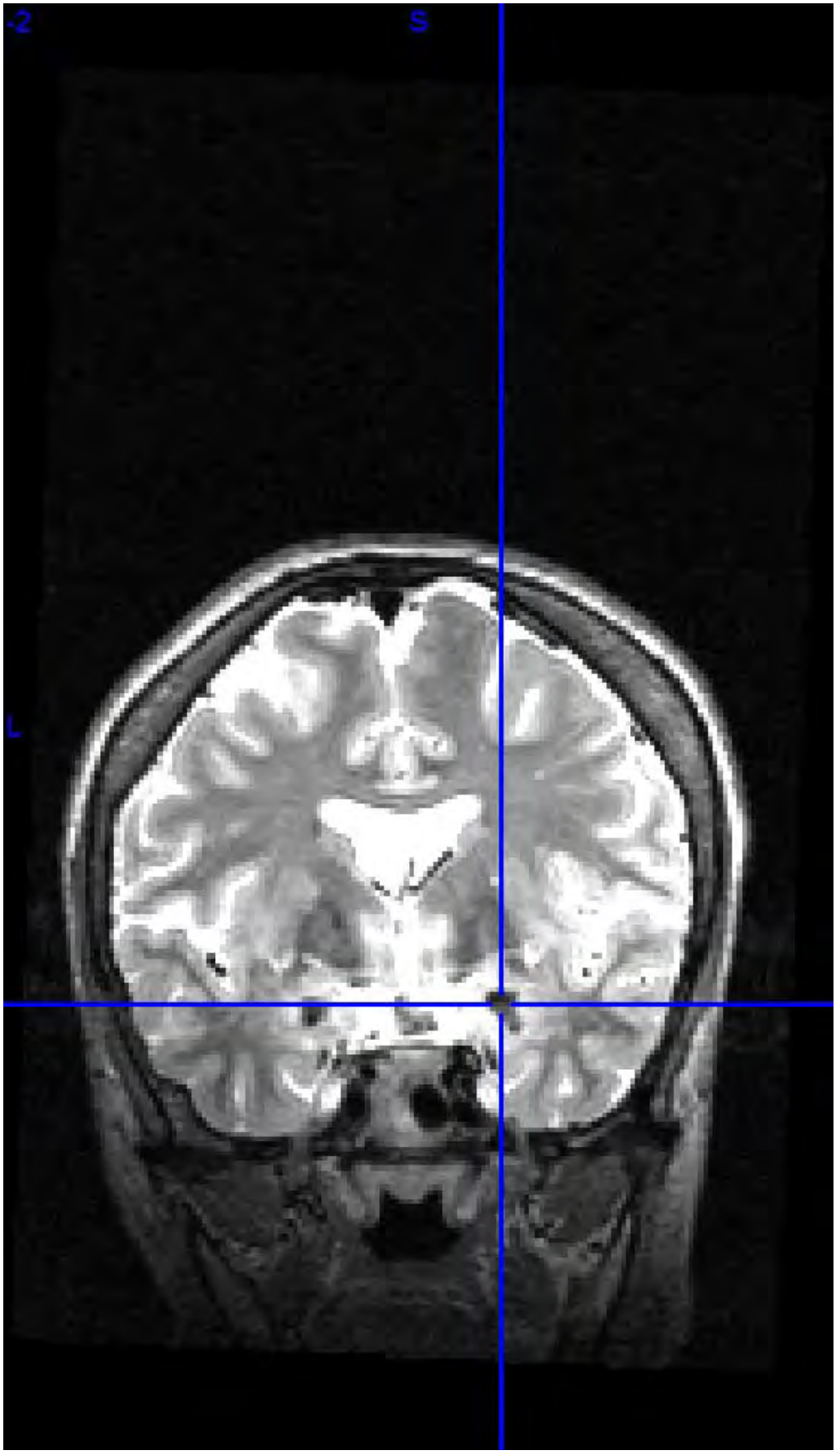

Figure 9. MRI scan for UWD patient no. 6.

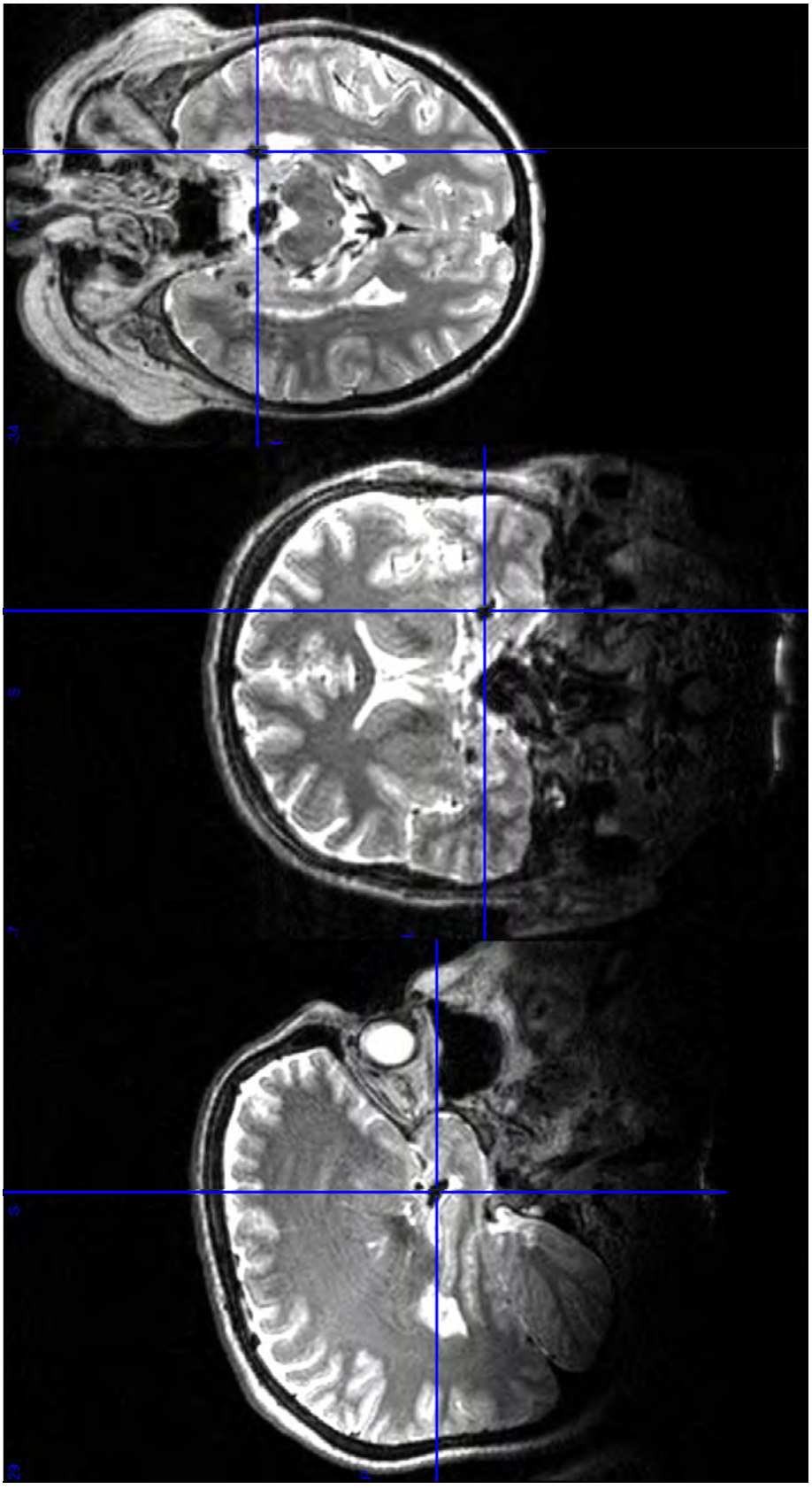

Figure 10. MRI scans for UWD patient no. 7.

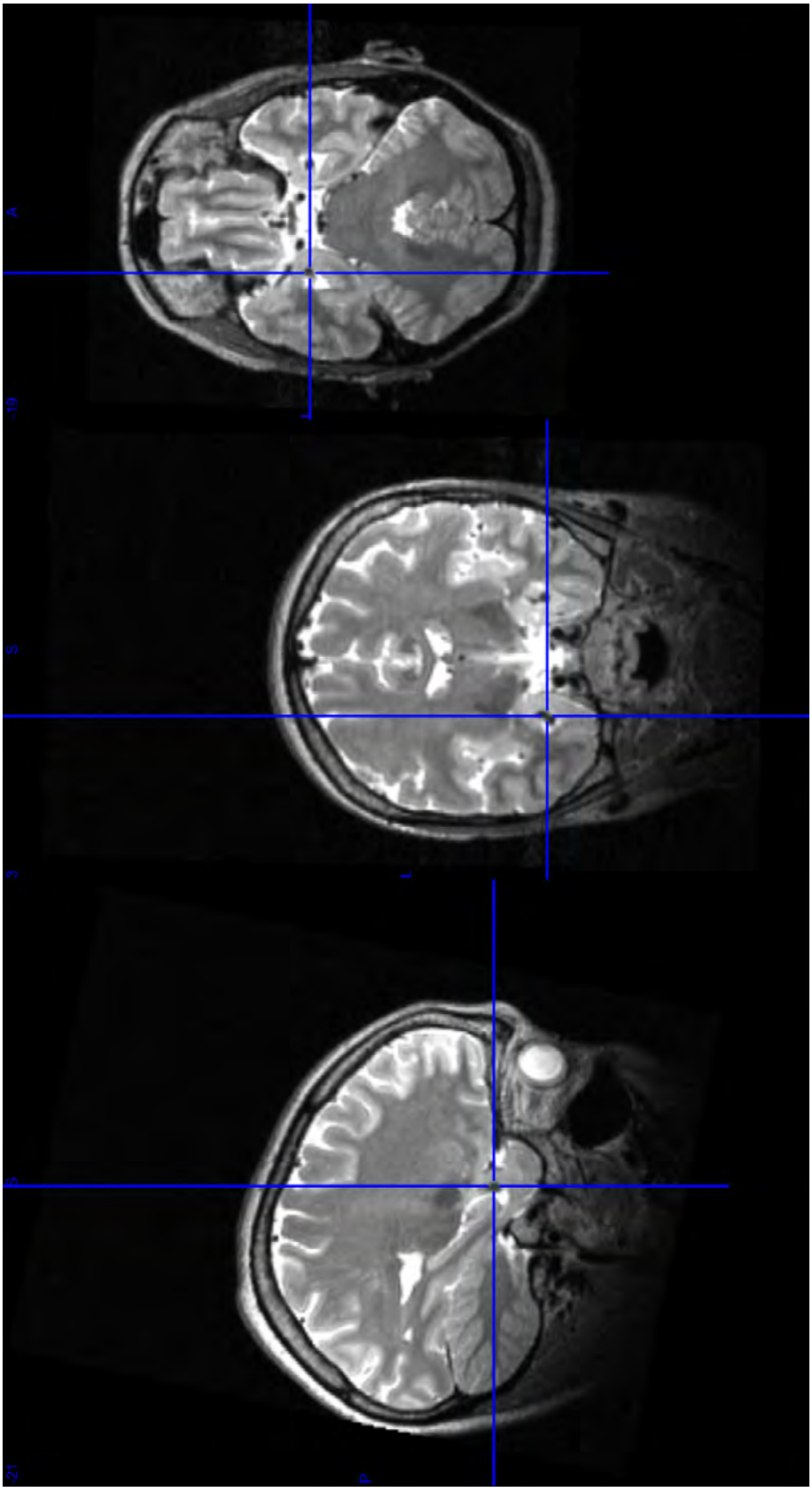

Figure 11. MRI scans for UWD patient no. 8.

APPENDIX B

The MRD Report Questionnaire

We would like you to describe the last dream you remember having, whether it was last night, last month, or last year.

Please describe the dream exactly and as fully as you remember it. Your report should contain, whenever possible: a description of the setting of the dream, whether it was familiar to you or not; a description of the people, their age, sex, and relationship to you; and any animals that appeared in the dream. If possible describe your feelings during the dream and whether it was pleasant or unpleasant. Be sure to describe exactly what happened to you and the other characters in the dream. Continue your report on the other side and on additional sheets if necessary.

APPENDIX C

Instructions for Research Assistants

General Overview

The work I'm going to ask you to do will involve coding a series of dreams along different measures.

For each coding measure, I'll first train you in the coding methods and have you code practice dreams.

Most of the measures you will be coding individually. So once we've finished practicing, you'll code 10 dreams on your own and I'll calculate inter-rater reliability based on your coding for these dreams; we'll aim to achieve 80% consensus on the practice dreams before you can start with the actual data analysis. Then you can complete this coding in your own time at home.

For the eight emotional categories, and for the bizarreness scale, you'll need to code by consensus. This entails that you will discuss the rating of each dream on each of these measures amongst yourselves until you all agree, and then you'll record the result. I won't be involved in this coding at all; although I will be in the room with you should any problems arise.

AFFECT

1) Here, you are required to decide, by consensus to what extent each of the following categories of emotion is present in the dream that you are coding. Please rate all seven categories of emotion for each dream.

A	Anger/Rage: Aggression:	Anger refers to feelings of strong displeasure or hostility; annoyance; irritation; fury; resentment. Rage refers to feelings of violent explosive anger. Hostility; violence; feelings of aggression.
B	Sexual Love/Erotism:	Sexual love refers to the fulfilment of sexual gratification of any kind. The desire for sexual gratification, or the *anticipation* of any sexual interactions, should be rated under category D.
C	Playfulness: Joy: Exuberance:	Finding or making causes for amusement; pleasantly humorous or jesting; full of fun and high spirits. Any actions relating to play should be rated here as well. Happiness; pleasure; enjoyment; bliss; delight. Enthusiasm; excitement; liveliness; energy; high spirits; cheerfulness
D	Seeking/Curiosity: Anticipation:	To try to locate or discover; the act of searching for something; to try to obtain. *Curiosity* refers to feelings of inquisitiveness or interest. To look forward to, especially with pleasure; expectance; suspense; hopefulness.
E	Care/Nurturance: Affection:	To watch over; be responsible for; physical and emotional care and nourishment; to nurture someone or something. A feeling of warm personal attachment or deep affection, as for a parent, child, spouse or friend. Feelings of love should be included here only if of a non-sexual type – if feelings of love are both sexual and affectionate, then both categories (B and E) should be chosen.
F	Fear: Anxiety: Apprehension:	A distressing emotion aroused by impending danger, evil, pain, etc., whether the threat is real or imagined; the feeling or condition of being afraid; dismay, dread, terror, fright, panic. Distress or uneasiness of mind caused by fear of danger or misfortune. Uneasiness; worry; nervousness; hesitation.
G	Sorrow/Grief/Loss:	Mental suffering or pain caused by separation, loss or despair; a feeling of being upset; a source of deep mental anguish, torment, distress.

Please use the following 0-3 scale:

3=these emotions were very intense
2= a moderate amount of these emotions were present
1=very little of these emotions were present
0= these emotions were absent

1. On the same 0-3 scale (but working individually) – please rate:

A – The general intensity of the positive affect (i.e. pleasant emotion) shown in the dream as a whole.
B – The general intensity of the negative affect (i.e. unpleasant emotion) shown in the dream as a whole.

2. Individually, using another 0-3 scale, please rate the extent to which you think this dream contains the fulfilment of a wish.

A wish fulfilling dream is defined as any dream in which something that the dreamer seeks, wants, or would enjoy (or that we can reasonably assume that the dreamer seeks, wants or would enjoy) does in fact take place. The wish can be something very simple or mundane, like eating ice-cream or even drinking water, or complex like achieving an abstract goal.

Please use the following 0-3 scale:
3=this dream is completely wish-fulfilling
2=this dream includes a clear wish-fulfilment but also includes other aspects
1=this dream has some elements of wish fulfilment but is predominantly not a wish fulfilling dream.
0=this dream includes no wish-fulfilling elements.

Examples:
3: “I dreamt that my deceased pet dog was alive again, and I hugged him.”
2: “I was running towards a cliff and felt scared but then realised I was able to fly, so I dived off the cliff and enjoyed flying over a beautiful landscape.”
1: “I was lost in a scary part of town when a stranger came up to me and offered help. I was very relieved, but then suddenly I was on my own and scared again. Then I woke up.”
0: “I dreamt I was being chased by a person I remember from childhood, who I was always scared of”.

3. Would you call this dream a nightmare? Please answer yes or no individually. Please make this decision based on a common-sense understanding of what a nightmare is, namely:

“Dreams marked by intensified feelings of dread or terror or other highly disturbing or unpleasant emotions, often with vivid visual imagery. These feelings are so intense that they typically cause the individual to wake up.”

Threat

Please choose either yes or no in response to each question, except for question 3, where you are required to choose between ancestral or modern. Note: If the answer to question 1 is no, do not continue with the other questions. If the answer to question 4 is no, do not answer question 5.

1) Does the dream contain a realistic physical threat to the dreamer?
   If yes:
2) Is the threat life threatening?
3) Is the threat ancestral or modern?
   Ancestral: ecologically valid threats - those present in our ancestral past, or similar to those present in our ancestral past, e.g. violent crime (murder, rape, assault, robbery) – include being threatened with a gun or shot at.
   Modern: Significant physical threats which have no equivalent in our ancestral past, e.g. major surgery, traffic accidents, airplane disasters, hijacking.
4) Does the dreamer escape the threat?
   If yes:
5) Is the escape realistic?

Avoidance and Approach Behaviour

1) Decide whether the main activity in the dream as a whole involves 'avoidance' or 'approach' behaviour on the dreamer's part. The behaviour must be rated either 'avoidance' or 'approach'; there is no other alternative. If more than one event is described, code the sequence of events as a whole. 'Avoidance' behaviour is defined as: 'the main activity of the subject of the dream is an attempt to avoid something through fleeing, freezing, hiding or the like'. 'Approach' behaviour is defined as: 'the main action of the subject of the dream is an attempt to approach something through engagement, exploration, curiosity or the like'. Code the dream in accordance with the dreamer's actual behaviour rather than their feelings, even if these contradict each other. For example, if the dreamer approaches an unknown place despite feeling scared, that is an instance of 'approach' behaviour. Likewise, if the dreamer is curious about an unknown person but hides away from him/her, that is 'avoidance' behaviour.

The following are prototypical examples of 'avoidance' and 'approach' behaviours, based on the scientific literature. These examples are not meant to be exhaustive; they just describe good examples of the two types.

Typical examples of 'approach' behaviour:

1. The dreamer engages with a thing/place/person/problem in an invigorated exploratory fashion, investigating or puzzling over it or trying to make sense of it.

2. The dreamer acts in a persistently or intensely interested/curious/inquisitive fashion.

3. The dreamer is eagerly seeking new sensations or exciting experiences.

4. The dreamer is searching for something or pursuing a goal, even if s/he does not or cannot achieve it.

5. The dreamer acts as though s/he is looking forward to something and/or anticipating something.

6. Almost any little thing stimulates the dreamer's interest.

Typical examples of 'avoidance' behaviour:

1. The dreamer is acting in an apprehensive, tense, worried or generally nervous fashion.

2. The dreamer is attempting to escape and avoid something unpleasant.

3. The dreamer is frozen or rooted to the spot by something frightening.

4. The dreamer is stuck and cannot reach a decision about something.

5. The dreamer misses an opportunity due to worry or anxiety.

6. The dreamer acts as though s/he dreads something bad.

WORD COUNT

The first counted word will be the first word that describes the dream, and the count will end with the last word. Do not count the answers to questions following the initial report. Introductory words such as "*I dreamt that*" and words that indicate clearly waking activity such as "…*when I woke up I thought about the dream/story*" will be excluded from the story or dream word count. Repetition and words implying hesitation will be excluded from the count. Example:

Child: I, er, dreamt that dogs, um, that dogs came into my room. Then I woke up.

1 2 3 4 5

Repetition that includes new information will be included. Affirmative or negative single words or phrase answers such as *"yes", "yes, I do", "no", "no, I don't", "I can't remember"*, will not be counted. Example:

Child: Yes, I remember, that, er, I dreamt that dogs, uhm, that big dogs came into my room.

1 2 3 4 5 6 7

NARRATIVE ITEM COUNT

The narrative item count will represent the number of meaningful chunks of information contained in the dream report. The same basic guidelines as per word count will be used. However, the entire dream report should be considered. Every event, action, dialogue, thought, feeling, etc. that forms a part of the dream will be counted. Introductory words such as "*I dreamt that / I remember that*" and words that clearly indicate waking activity such as "…*when I woke up I thought about the dream/story*" will be excluded from the count, as will any reference to waking life that does not form part of the actual dream report. Exclude the word "and", repetition, and words implying hesitation. Repetition of the same narrative item will be ignored even if it is expressed in different wording. However, if the repetition includes new information, then that new information will be counted.

Example:

Child: *In my dream there was a boy named Max and he was sent to his room without supper.*

1 2 3 4 5 6 7

BIZARRENESS

1) Here, please first identify each content element and assign it to a content category. Once you have done this, please indicate on the form how many instance of each content category you observed.

2) Now, please identify each content element as either: non-bizarre, incongruous (distorted, exotic, or impossible), vague, or discontinuous. Please indicate on the form how many of each bizarreness-type you observed under each content category.

The Content Analysis of Bizarreness Scale.[1]

Scoring is carried out in two stages: (1) Element identification and (2) Content/bizarreness scoring (see text for details). The use of this scale requires that there is adequate background information concerning how the dream events relate to the personal waking reality of the dreamer.

Identification of Content Elements

General principles

(1) Every identified element is assigned to one and only one content category.

(2) Every dream element carrying novel information is identified when it is mentioned for the first time in the dream report. For example, an object and all the adjectives used to describe its features are each identified as distinct elements.

(3) If new features of a previously mentioned element are mentioned, they are scored as new elements. Redundant information is not to be scored.

(4) An element is identified only when it is explicitly mentioned in the dream report. No elements are to be inferred on the basis of context.

(5) Elements are identified only in such parts of the dream report which are described as real events from the point of view of the dreamer. If dreamed events or objects are represented as unreal

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[1]The original scale used in this study as well as the dreams analyzed were in Finnish. Some of the translations presented here may be only approximate.

> in the dream (e.g. events or objects in a movie watched in the dream) they are not to be scored.

There are 14 content element categories. Of these, seven refer to different kinds of object-like entities which are directly perceived in the dream (Self, Place, Persons, Animals, Body Parts, Plants, Objects). In the dream report, these elements consist of (1) nouns referring to these entities (e.g., dog, man, home, tree, table) or (2) adjectives or other words describing the perceptible features of these entities (e.g., big, small, old, green, angry, broken). The rest of the content categories refer to different kinds of entities and their identification is explained below in detail.

Classification of bizarreness

(1) Every bizarre feature is scored as bizarre only when it is mentioned for the first time in the dream. The bizarre element sets the context for what can be considered as a further bizarreness. Thus, the direct implications of a bizarre assumption in the dream are not themselves considered as independently bizarre. Only elements which bring further bizarre assumptions to the dream are scored as independently bizarre (cf. Hunt, 1982, p.594). Thus, dreaming of seeing a kangaroo in the bushes on my backyard is scored as a bizarre animal (animal in a wrong context). But if I dream that I am in Australia and in this dream there is a kangaroo in the bushes, it is not an exotic animal in this context, but Australia is scored as a bizarre place (the place is an unlikely context for me). And if I next see cloudberries growing in a forest in Australia, this is of course a bizarre plant (plant in a wrong context).

(2) Every element is non-bizarre until shown to be bizarre. That is, if the judges disagree as to whether a certain element is bizarre or not, the burden of proof is on the one claiming that the element is bizarre.

There are 3 mutually exclusive bizarreness categories and 1 non-exclusive category. The general features of the

Bizarreness Categories:

1. Non-bizarre element. A dream element (or its feature) which is ordinary and congruous with waking reality.
Example: I dream that I am in my room which appears as it is in waking reality [*non-bizarre place*].

2. Incongruous element. A dream element which has at least one of the following properties:

> 2a. Internally distorted or contextually incongruous elements. An element which has a feature that does not belong to it in waking reality or which appears in a context in which it would not appear in waking reality.

Example: My room is much bigger than it is in reality [internally distorted place]. My room is in the middle of a forest [contextually incongruous place].

2b. Exotic elements. An element which is highly unlikely to occur in the dreamer's waking reality, but the occurrence of which is nevertheless possible in principle.
Example: I was in a tropical jungle [exotic place].
I met the Secretary General of the United Nations [exotic character].
2c. Impossible elements. An element or a feature of an element the existence or occurrence of which is not possible in waking reality.
My dead grandfather came to visit us [impossible character]. I was flying above the city like Superman [impossible action]. We were on an alien planet [impossible place].

3. Vague element. An element or a feature of an element the character or identity of which is indeterminate, unknown or obscure in a way which does not occur in waking life.

Example: I was in a place which was my room but at the same time it was also a submarine [indeterminate identity of place].
I was in some city but I do not know or remember which one [vague identity of place].

Bizarreness categories 1-3 are mutually exclusive and each content element falls into one and only one of these categories. There was a further bizarreness category in addition to these which could be assigned to a content element.

4. Discontinuous element. An element which is temporally discontinuous; it suddenly and unexpectedly appears or disappears or is transformed in the dream. The content of a discontinuous element is always the one to which the element belongs after the transformation. In case the discontinuity is total (i.e. everything else but the Self changes) but the discontinuity is not in any way noticed or commented (e.g. "and *suddenly* I was..."), it is considered and scored as a whole new dream, not a discontinuity within one dream.

This category was not mutually exclusive with the others, since an element can be discontinuous independently of whether it is non-bizarre, incongruous, or vague.

DEFINITIONS OF CONTENT CATEGORIES AND BIZARRE CONTENT ELEMENTS
1. Self

Definition: The subject (or its features) who acts in or observes the dream world. The person or being from whose point of view the dream world is experienced and who appears in the first person in the dream report. The features scored as features of Self are those which belong to the identity of the Self (age, sex, size, race, profession).

1.1. *Non-Bizarre Self*

The self in the dream is not mentioned being in any way different from the corresponding person in the real world. The self of the dream is essentially the same person with features similar to the dreamer's self when awake.

1.2. *Incongruous Self*

a) [Distorted] The self in the dream has a feature which does not belong to the person in real life. The dream self is the waking self, but somehow distorted (e.g. different age, sex, profession, social status etc.).

b) [Exotic] The self in the dream is not the same person as in real life. The dream self is identified as a different person, not only as a distortion of the waking person.

c) [Impossible] The self in the dream is not a real human being at all. It is an animal, a robot, a supernatural being, or some other fictional or unreal character.

1.3. *Vague Self*

There is no determinate self in the dream, or it is very obscure or indeterminate and difficult to describe.

1.4. *Discontinuous Self*

The self in the dream suddenly and unexpectedly appears, transforms or disappears.

2. Place

Definition: The immediate surroundings (and its features) and geographical location of the dream events or the dream self. For example: room, building, street, forest, train, city, country. Implies that the dream events are represented from a point of view within the place. If e.g. a building is observed only from the outside, it falls under the category of Object. Features of Place include, for example, temperature and other weather conditions (darkness, lightness), and all "global" features which are not features of a single Object or other element in the Place.

2.1. *Non-Bizarre Place*

The place in the dream is either a familiar place similar to the one in the real world or an unfamiliar but ordinary place.

2.2. *Incongruous Place*

a) [Distorted] A familiar place which in the dream has a feature which does not belong to it in real life. Also a familiar place in a wrong geographical or temporal context.

b) [Exotic] A place which is very unfamiliar and a very unlikely one for the subject to find himself in in real life.

c) [Impossible] A place in which it is not physically possible for the subject to be (e.g. outer space, a fictional place).

2.3. *Vague Place*

A place the nature or identity of which is obscure or indeterminate.

2.4. *Discontinuous Place*

A sudden and unexpected appearance, transformation, or disappearance of the place.

3. Time

Definition: The explicitly mentioned temporal context of the dream events. Time of the day, date, month, season, year, era.

3.1. *Non-bizarre time*

The time mentioned in the dream is normal and well in accordance with the dream events (e.g. going to work at 8 o'clock in the morning).

3.2. *Incongruous time*

a) [Distortion] The time mentioned in the dream is not congruous with the dream events (e.g. it is night but the sun is shining).

b)[Exotic time] The time mentioned in the dream clearly deviates from the present real time and is far from the present reality of the dreamer, but belongs to his or her possible past or future.

c)[Impossible time] The time mentioned in the dream cannot belong to the possible personal past or future of the dreamer. The dream events take place in the distant past or future.

3.3. *Vague time*

The time of the dream events is obscure or indeterminate.

3.4. *Discontinuous time*

A sudden and unexpected change of or break in the temporal context of the dream.

4. Persons

Definition: The human or humanoid or other intelligent characters, and groups formed by such characters, perceived by the subject in the dream. Features to be scored as features of persons include age, sex, size, race, profession.

4.1. *Non-bizarre person*

A familiar person who is not mentioned differing from the corresponding real person or an unfamiliar but ordinary person.

4.2. *Incongruous person*

a)[Distorted person] A person with a feature that does not belong to that person in reality (e.g. different appearance or age) or a person in a wrong context (e.g. in a different role or place).

b) [Exotic person] A person that is very unlikely to be met by the dreamer in real life.

c) [Impossible person] A person that does not or cannot exist (e.g. a dead or a fictional character)

4.3. *Vague person*

A person whose presence or nature or identity is obscure or indeterminate.

4.4. *Discontinuous person*

A person who suddenly and unexpectedly appears, transforms, or disappears.

5. Animals

Definition: Animate characters other than Persons perceived in the dream, and groups formed by such characters. Includes non-humanlike unknown monsters and alien creatures.

4.1. *Non-bizarre animal*

A familiar or ordinary (species of) animal.

4.2. *Incongruous animal*

a)[Distorted animal] An animal with a feature that does not belong to it in reality (e.g. different appearance) or an animal appearing in a wrong context.

b) [Exotic animal] An animal that is very unlikely to be met by the dreamer in real life.

c) [Impossible animal] An animal which does not or cannot exist.

4.3. *Vague animal*

An animal whose presence or nature or identity is obscure or indeterminate.

4.4. *Discontinuous animal*

An animal which suddenly and unexpectedly appears, is transformed, or disappears.

6. Body Parts

Definition: Human and animal bodies and their parts and features perceived in the dream. The parts can belong to a character (the beak of a bird) or they may be detached (a bearskin, a tooth). Also the fluids of the body (blood, slime, etc.) and perceivable injuries of the body (bruises, tumors, bumps, rash, pimples, etc.).

4.1. *Non-bizarre body part*

An ordinary body part which is does not differ from the corresponding real one.

4.2. *Incongruous body part*

a)[Distorted body part] A body part with a feature that does not belong to it in reality (e.g. different appearance) or a body part in a wrong context (e.g. an additional or missing body part).

b) [Exotic body part] A body part that is very unlikely to be met by the dreamer in real life (the trunk of an elephant, synthetic body parts).

c) [Impossible body part] A body part which does not or cannot exist (e.g. detached but living and moving body parts)

4.3. *Vague body part*

A body part whose presence or nature or identity is obscure or indeterminate.

4.4. *Discontinuous body part*

A body part which suddenly and unexpectedly appears, is transformed, or disappears.

7. Plants

Definition: All kinds of vegetation (trees, flowers, bushes, mushrooms, grass) and their parts (berries, fruits, vegetables, roots, branches, leaves) perceived in the dream.

4.1. *Non-bizarre plant*

A familiar plant which is not mentioned differing from the corresponding real plant or an unfamiliar but ordinary one.

4.2. *Incongruous plant*

a)[Distorted plant] A plant with a feature that does not belong to it in reality (e.g. different appearance) or a plant in a wrong context.

b) [Exotic plant] A plant that the dreamer is very unlikely to come across in real life.

c) [Impossible plant] A plant which does not or cannot exist (e.g. moving plants)

4.3. *Vague plant*

A plant whose presence or nature or identity is obscure or indeterminate.

4.4. *Discontinuous plant*

A plant which suddenly and unexpectedly appears, is transformed, or disappears.

8. Objects

Definition: A part (or a feature of a part) of the inanimate environment, which is perceived in the dream. Different objects can be perceived in different ways (vision, touch, hearing).

4.1. *Non-bizarre object*

A familiar object which is not mentioned differing from the corresponding real object or an unfamiliar but ordinary one.

4.2. *Incongruous object*

a)[Distorted object] An object with a feature that does not belong to that object in reality (e.g. different appearance), or an object in a wrong context (e.g. in an inappropriate place).

b) [Exotic object] An object that the dreamer is very unlikely to come across in real life.

c) [Impossible object] An object which does not or cannot exist.

4.3. *Vague object*

An object whose presence or nature or identity is obscure or indeterminate.

4.4. *Discontinuous object*

An object which suddenly and unexpectedly appears, is transformed, or disappears.

9. Events

Definition: Events are causal changes taking place in the inanimate environment or in animate objects, which cannot be considered as the intentional actions of any single character (e.g. weather processes, the behaviour of objects when not guided by dream characters, collective events like wars, riots, gatherings). Incidents which happen to the dream characters without their control (bumping into something, finding something etc.).

4.1. *Non-bizarre event*

A familiar event or incident which is not mentioned differing from the corresponding real event or an unfamiliar but ordinary one.

4.2. *Incongruous event*

a)[Distorted event] An event with a feature that does not belong to that event in reality (e.g. the event does not have its regular causal consequences), or an event in a wrong context (e.g. in a different role or place).

b) [Exotic event] An event that is very unlikely to take place in real life (e.g. the eruption of a volcano in England).

c) [Impossible event] An event which does not or cannot take place (e.g. objects flying by themselves, broken objects mending by themselves)

4.3. *Vague event*

An event whose presence or nature or identity is obscure or indeterminate.

4.4. *Discontinuous event*

An event which suddenly and unexpectedly appears, is transformed, or disappears (e.g. a sudden event taking place without any preceding causal antecedent).

10. Action

Definition: Actions are intentional acts carried out by the animate characters in the dream. Also the behaviour of devices directly controlled or assumed to be controlled by animate characters (cars, airplanes). Also actions of speaking when no referral to the content of speech is made (content belongs to Language). If action is only planned but not carried out by the Self, it belongs to Cognition.

4.1. *Non-bizarre action*

A familiar action which is not mentioned differing from the corresponding real action or an unfamiliar but ordinary action.

4.2. *Incongruous action*

a)[Distorted action] An action with a feature that does not belong to that action in reality (e.g. abnormal or repeated failure in a trivial action) or an action in a wrong context (e.g. in an inappropriate role or place).

b) [Exotic action] An action that is very unlikely to be carried out in real life (e.g. very risky or perverted or criminal action).

c) [Impossible action] An action which is not physically possible (e.g. flying by flapping one's arms, breathing under water without diving equipment)

4.3. *Vague action*

An action whose presence or nature or identity is obscure or indeterminate.

4.4. *Discontinuous action*

An action which suddenly and unexpectedly (unmotivatedly) is carried out, transformed, or suspended and forgotten.

11. Language

Definition: Words and sentences uttered by the animate characters in the dream and other linguistic messages and symbols: writing, text, numerical symbols. The message is evaluated by its form and its content.

4.1. *Non-bizarre language*

An ordinary expression which has a grammatically correct form and a content semantically and pragmatically appropriate.

4.2. *Incongruous language*

a)[Distorted language] An expression with a feature that does not belong to normal colloquial language (e.g. grammatical errors, semantical errors, neologisms), or a grammatically correct expression in a wrong context (e.g. use of foreign language, a message uttered by an inappropriate speaker, or expressing a statement which does not correspond with reality).

b) [Exotic language] An expression that is very unlikely to be uttered in real life (e.g. expresses an extremely absurd thought or illogical reasoning)

c) [Impossible language] An expression which is completely irrelevant, irrational and absurd and does not make any sense at all.

4.3. *Vague language*

An expression whose presence or nature or identity is obscure or indeterminate.

4.4. *Discontinuous language*

An expression which suddenly and unexpectedly appears, is transformed, or disappears.

12. Cognition

Definition: The internal intellectual and mental functions of the Self. For example: internal speech, thoughts, beliefs, value judgements, reflection on events, planning, problem solving, decision making, reasoning, mental imagery, knowing and understanding. The mental functions of other characters in the dream are not scored in this category but according to how they are perceived by the subject (as speech, action, emotion etc.).

4.1. *Non-bizarre cognition*

A familiar or logical or otherwise adequate thought or cognitive process.

4.2. *Incongruous cognition*

a)[Distorted cognition] A thought or cognitive process with a feature that does not belong to it (e.g. grammatical or semantic errors in internal speech, false memories, false understanding, uncritical acceptance of dubious beliefs, delusional beliefs not based on anything actually perceived in the dream, false or unfounded knowledge).

b) [Exotic cognition] Disoriented, irrational and illogical cognitive functioning.

c) [Impossible cognition] Loss of control of cognitive processes, continuous obsessive thoughts or mental images, irrelevant and disorganized thoughts, inability to think at all, termination of all voluntary cognitive processes.

4.3. *Vague cognition*

Cognitive processes whose presence or nature or is obscure or indeterminate.

4.4. *Discontinuous cognition*

Cognitive processes which suddenly and unexpectedly appear, are transformed, or disappear.

13. Emotions

Definition: Emotional states and feelings experienced and expressed by the dreamer or expressed by other dream characters. Includes emotions, feelings, moods, emotional attitudes (desires), and actions which refer to expression of emotions (crying, laughing).

4.1. *Non-bizarre emotion*

An emotion which is adequate in the context in question and would not be unlikely to appear in a corresponding waking situation.

4.2. *Incongruous emotion*

a)[Distorted emotion] An ordinary emotion with a feature that does not belong to it (exaggerated emotional reaction) or an emotion or lack of it which is unlikely in a comparable waking situation.

b) [Exotic emotion] A very extreme emotional reaction rarely encountered in waking life but which is somehow related to the dream events.

c) [Impossible emotion] A very extreme emotional reaction which is not in any way related to the dream events.

4.3. *Vague emotion*

An emotion whose presence or nature or identity is obscure or indeterminate.

4.4. *Discontinuous emotion*

An emotion which suddenly and unexpectedly appears, is transformed, or disappears.

14. Sensations

Definition: Sense experiences which occur independently of voluntary cognitive processes and which do not refer to objects outside of themselves (e.g. pains, itches, sensations of heat, pleasure, odor, nausea, sleepiness etc.).

4.1. *Non-bizarre sensation*

A familiar or ordinary sensation which appears in an appropriate context.

4.2. *Incongruous sensation*

a)[Distorted sensation] An ordinary sensation with a feature that does not normally belong to it (e.g. synesthesia, sensations of abnormal intensity, a sensation in an inappropriate context, or lack of normal sensation).

b) [Exotic sensation] A very unlikely sensory experience which is somehow related to the dream (e.g. blindness, deafness, disorganization of senses).

c) [Impossible sensation] Sensory experiences not physically possible (supernatural senses, indescribable or alien sensory experiences).

4.3. *Vague sensation*

A sensation whose presence or nature or identity is obscure or indeterminate.

4.4. *Discontinuous sensation*

A sensation which suddenly and unexpectedly appears, is transformed, or disappears.

APPENDIX D

Ethical Approval from the UCT Department of Psychology Ethics Committee

UNIVERSITY OF CAPE TOWN

Department of Psychology

University of Cape Town Rondebosch 7701 South Africa
Telephone (021) 650 3414
Fax No. (021) 650 4104

4 May 2009

Dr. Georg Fodor
c/o Department of Psychology
University of Cape Town
Rondebosch 7701

Dear Dr Fodor,

I am pleased to inform you that ethical clearance has been given for your project:

Emotional experience in Urbach-Wiethe Disease: A neuro-psychoanalytic stucy.

I wish you all the best for your study.

Yours sincerely,

Johann Louw PhD
Professor

APPENDIX E

Patient Information Sheet

You are invited to participate in a study on the effects of Lipoid Proteinosis (LP) on emotion and dreaming. Specifically, we are trying to document whether LP influences the emotional life or dreams of those affected by it.

If you consent to participate in this study, you will be required to answer the following questions (show questionnaires). The interviewer will be Sr. Mara Brandt and the interview will take place in private. Your responses will be recorded on a digital recorder (show recorder and memory card). Each participant will have their own memory card which will bear a number. No name or other personal information will be written on it. All the memory cards will be translated (your voice to English text) by one person who does not know you and who will only see the number on the card. This person will never know who you are.

The translation bearing the number will be analysed by another researcher who will also never know who you are or whether you have LP or not because your voice will not carry over from recording to text. Only once all the transcripts have been analysed will this researcher be told which transcript numbers are LP and which are not, as well as the age and sex of each transcript, but no names or other personal information will be given.

There are no anticipated personal risks involved in this research, apart from the temporary feelings associated with remembering distressing events. The data gathered from this research may be published, but your contribution and data will remain entirely anonymous.

Prior to the end of the interview there will be a debriefing session during which Sr Brandt will ask whether there is anything arising from this interview that you feel needs further attention (e.g. if the interview has triggered any strong emotions that you feel you need help coping with and you would like to talk to someone about). If so, Sr Brandt will discuss this with you in more detail and report back to Dr Morgan who will take the necessary action such as arranging for you to see a local psychologist or social worker. If you become aware of any problems once Sr Brandt has left you can contact her or Dr Morgan at any time (contact details below). You are free to withdraw from the study at any point, without having to provide a reason. NB: Your decision to participate or not participate will in no way impact on your ongoing medical care and treatment.

Should you have any questions or queries about the research or your participation, please do not hesitate to contact the investigators:

Dr Barak Morgan: 021 406 6840 (work); 083 417 6264 (cell)

Sr Mara Brandt: 027 682 2594 (home); 071 076 3999 (cell)

……..

I have read and understood this page and been given the opportunity to ask questions.

Signed: _____ on _____20____

Witness: _____